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MAY 1957

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6 HRX

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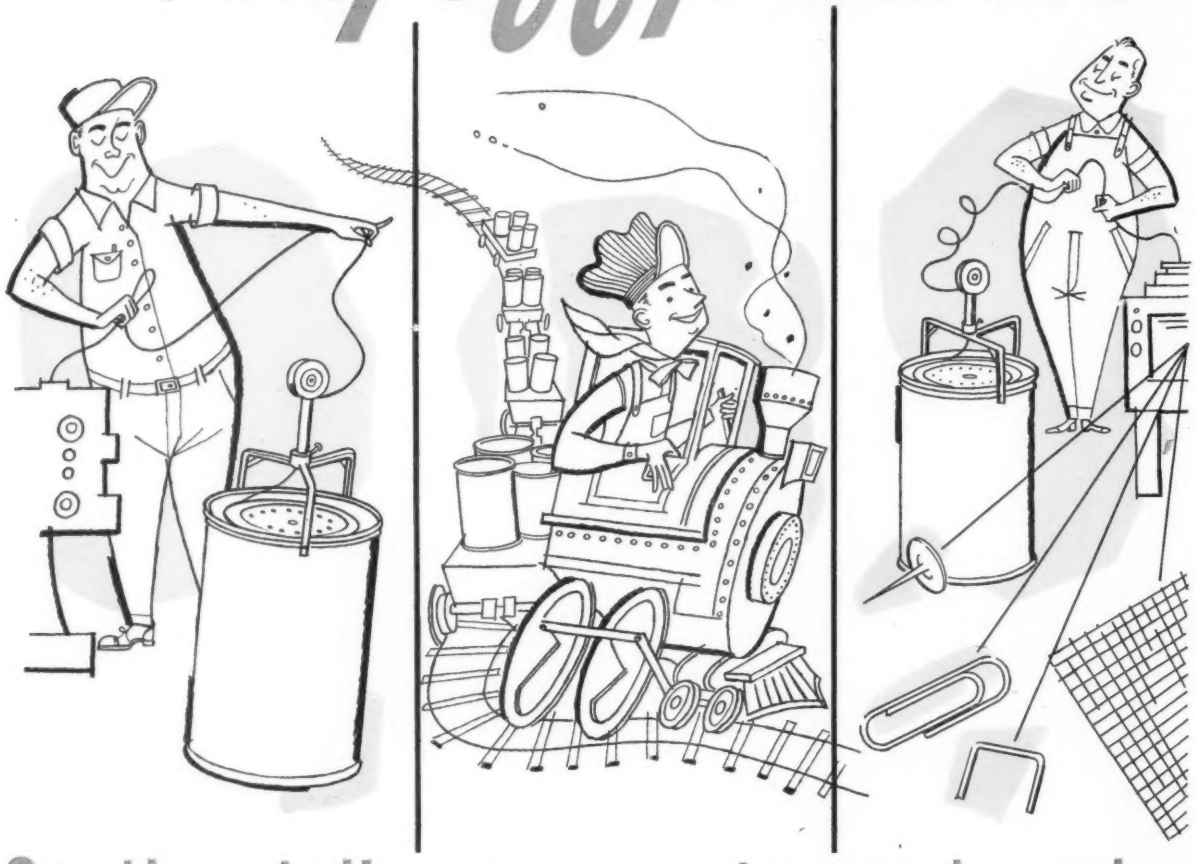

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Kaiser Aluminum Rod, Bar And Wire Handbook Makes Your Work Easier

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This handbook assists engineers, designers, production personnel and puchasing executives in the selection and use of the most suitable aluminum rod, bar and wire for many different applications.

And it contains information about the production of aluminum and its specific properties and characteristics as related to rod, bar and wire.

Covers A Wide Range Of Subjects

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WELDING—Complete run-downs on such welding methods as gas, carbon arc, atomic hydrogen arc, inert gas-shielded arc and resistance welding are given. Soldering, brazing and mechanical joining information is included.

ENGINEERING DATA—The *Rod, Bar And Wire Handbook* contains 59 pages full of time and work-saving engineering data and tables: "Decimal Equivalents Of Wire And Sheet Metal Gauges," "Comparative Physical And Mechanical Properties Of Metals," "Conversion Of Thermometer Readings," "Chemical Resistance Guide," and many, many more. All tables are easy to follow, easy to work with.

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You're sure to find helpful, usable information in every section of this up-to-date handbook. Kaiser Aluminum's *Rod, Bar And Wire Handbook* is one of the most complete books of its kind. Look at all it offers you.

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- The Role Of Aluminum In Modern Industry
- Production Of Aluminum
- Qualities Of Aluminum
- Aluminum Rod, Bar And Wire Products
- Aluminum Rod, Bar And Wire Alloys
- Fabrication
- Forming Techniques
- Welding, Soldering, Brazing And Mechanical Joining
- Finishing
- Engineering Data And Tables
- Nomenclature And Definitions

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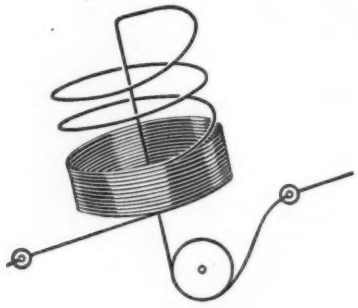

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 32 May, 1957 No. 5

Designated as Official Publication By The Wire Association

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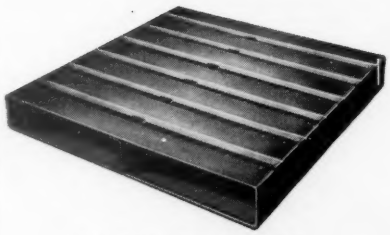
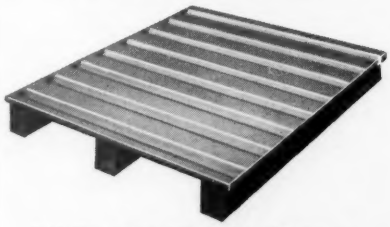
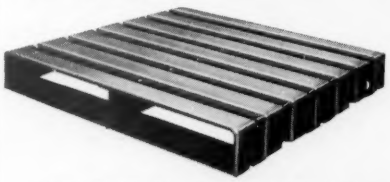


P-14 Double Face Steel Pallet.



P-12 Single Face Steel Pallet with two- or four-way entry.



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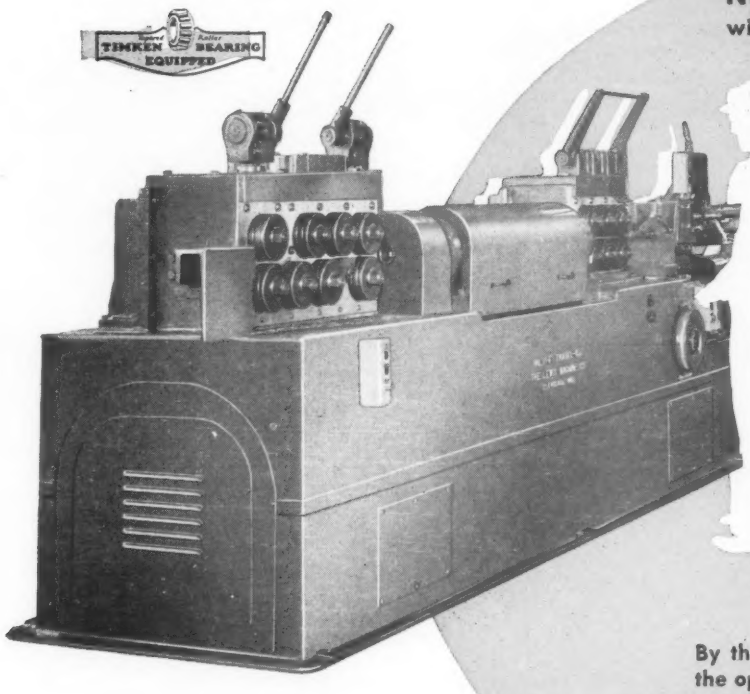

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with special extension

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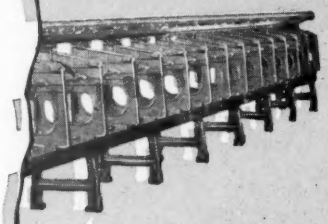

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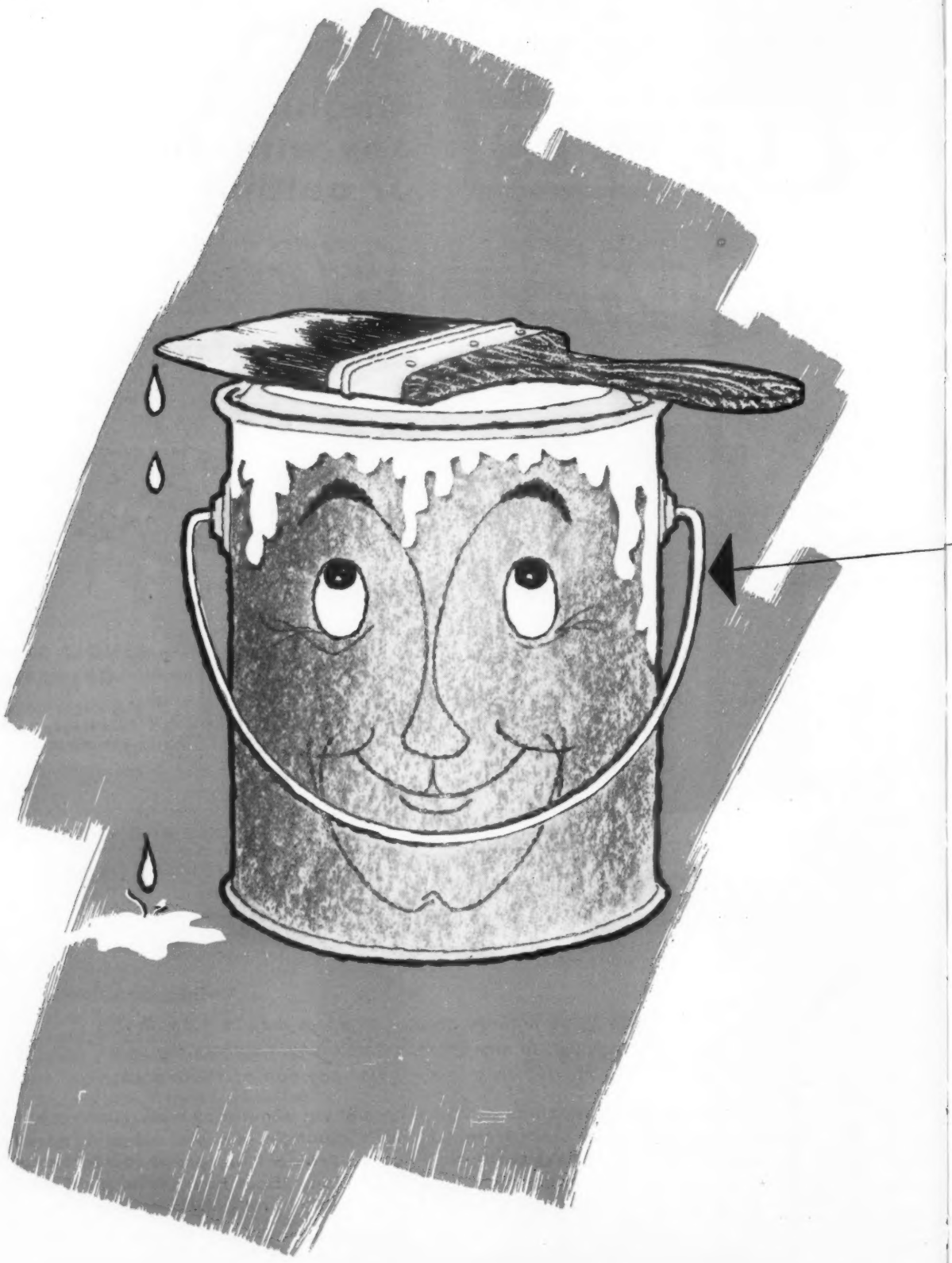

Painting is easier with a bucket which has a dependable, easy-to-use handle made from low carbon, hard drawn CF&I-Wickwire Pail Bail Wire.

Chances are you don't need pail bail wire to make paint bucket handles. But *you may need one or more of the nearly 100 different categories of specialty wire for which CF&I-Wickwire is famous.* Let us show you how we can meet your most rigid chemical and physical specifications on high and low carbon wire in all sizes, shapes, tempers, finishes and grades.

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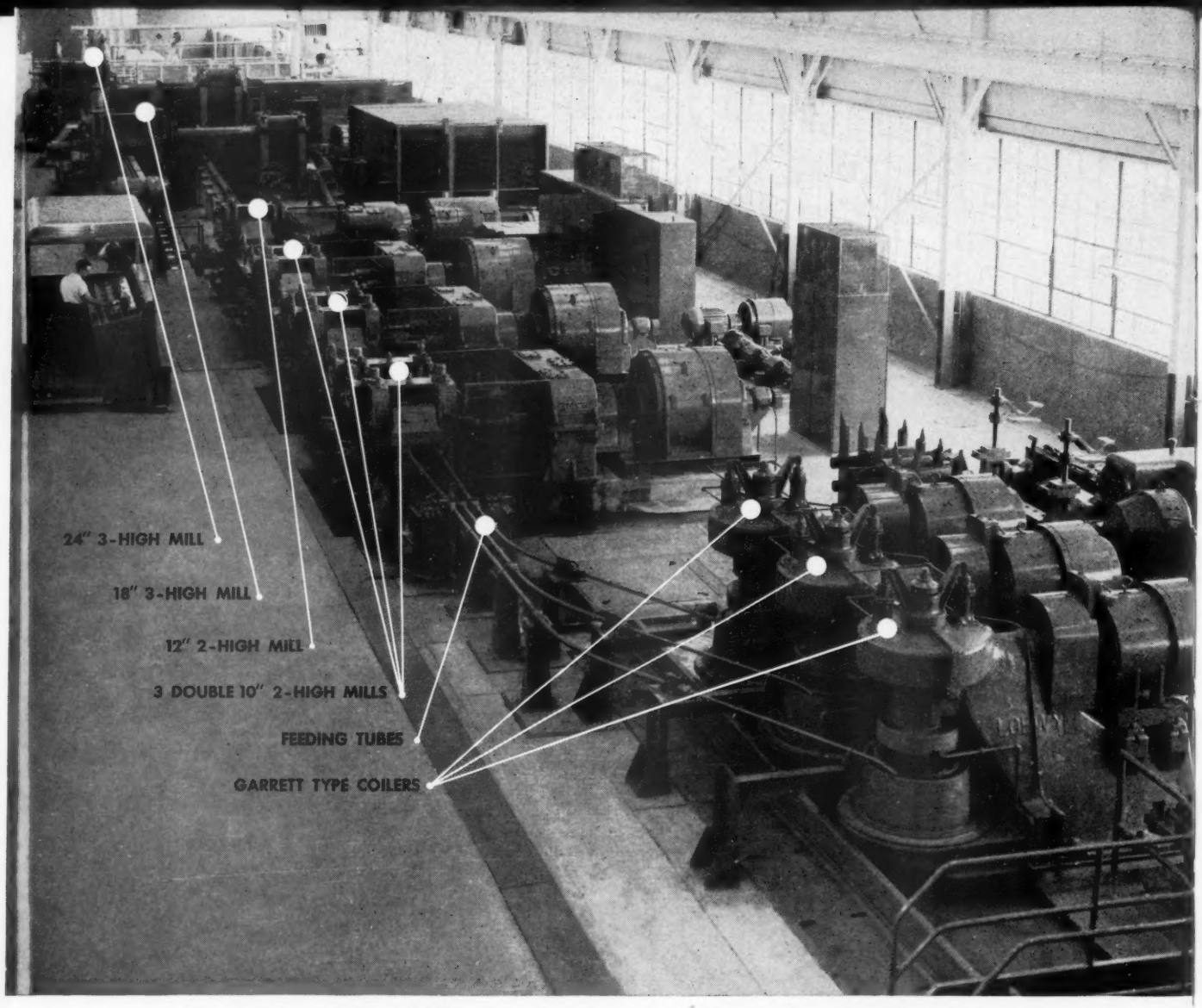

This installation has a capacity of 40,000 lbs per hour for 2-strand rolling with finished coil delivery every 19 seconds.

new Loewy copper wire rod mill reduces wire bars to 5/16" wire rod, automatically

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Anaconda power cable is lighter, more compact with insulation and jacketing of Du Pont ALATHON®

This new cable construction, insulated and jacketed with ALATHON polyethylene resin, has a smaller diameter than other non-leaded cables – less weight than leaded cables. The minimum weight results in lower shipping and installation costs plus easier handling. Du Pont ALATHON provides protection against moisture, oxidation, chemical exposure and mechanical damage.

The characteristics of Du Pont ALATHON polyethylene resin, used for insulation and jacketing, contribute to many of these advantages. ALATHON has an extremely low power factor and dielectric constant and, therefore, low dielectric loss. Negligible heat due to dielectric loss means that, compared with other insulations, a cable insulated with ALATHON pays dividends every year in load-carrying capacities – as much as $100 per year per thousand feet.

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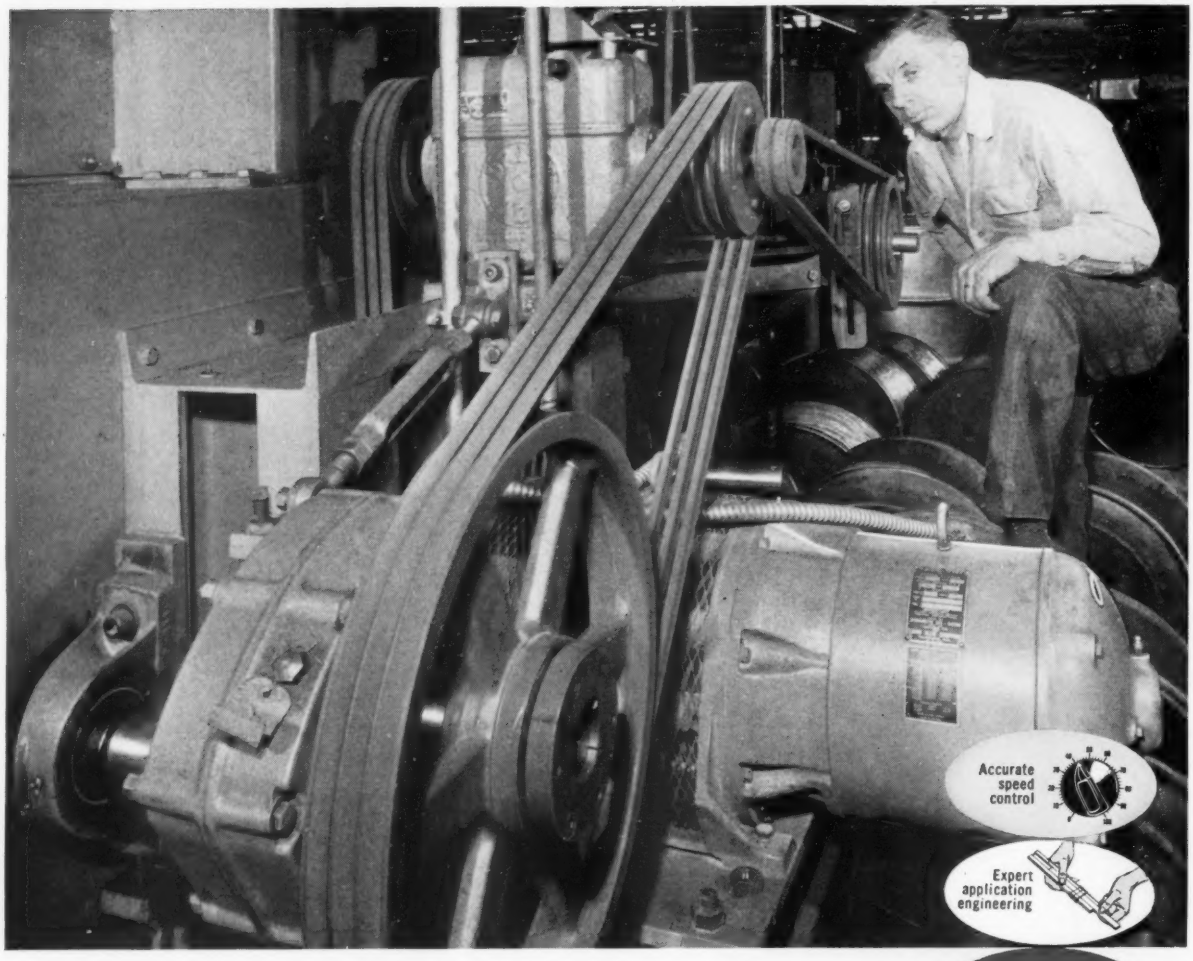

Louis Allis drives double production at Central Cable Company

Ajusto-Spede® drives improve extruding operation — cut costs 75% — slash rejects 90%

Central Cable Company, of Freeport, Illinois, is a major manufacturer of utility cable. In recent years they decided to improve their cable insulation by going to the extrusion process.

To power their extrusion lines, they found that of all the drives available, Louis Allis Ajusto-Spede® A. C. drives offered the greatest flexibility and precise speed control. Result: production increased 100% . . . manpower costs dropped from $240 to $60 per day . . . rejection rate because of improper insulation dropped from 10% to less than 1%.

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In addition, Louis Allis drives are controlled by one potentiometer, eliminate need for ac-dc converter. Equally important, the Louis Allis drives at Central Cable Company have not had a single breakdown since their installation in 1948 — nor have they required replacement or repairs of any kind.

For modernizing — or a new installation — consult Louis Allis *first*. Contact your nearby Louis Allis District Office or write to The Louis Allis Company, 451 East Stewart Street, Milwaukee 1, Wisconsin.

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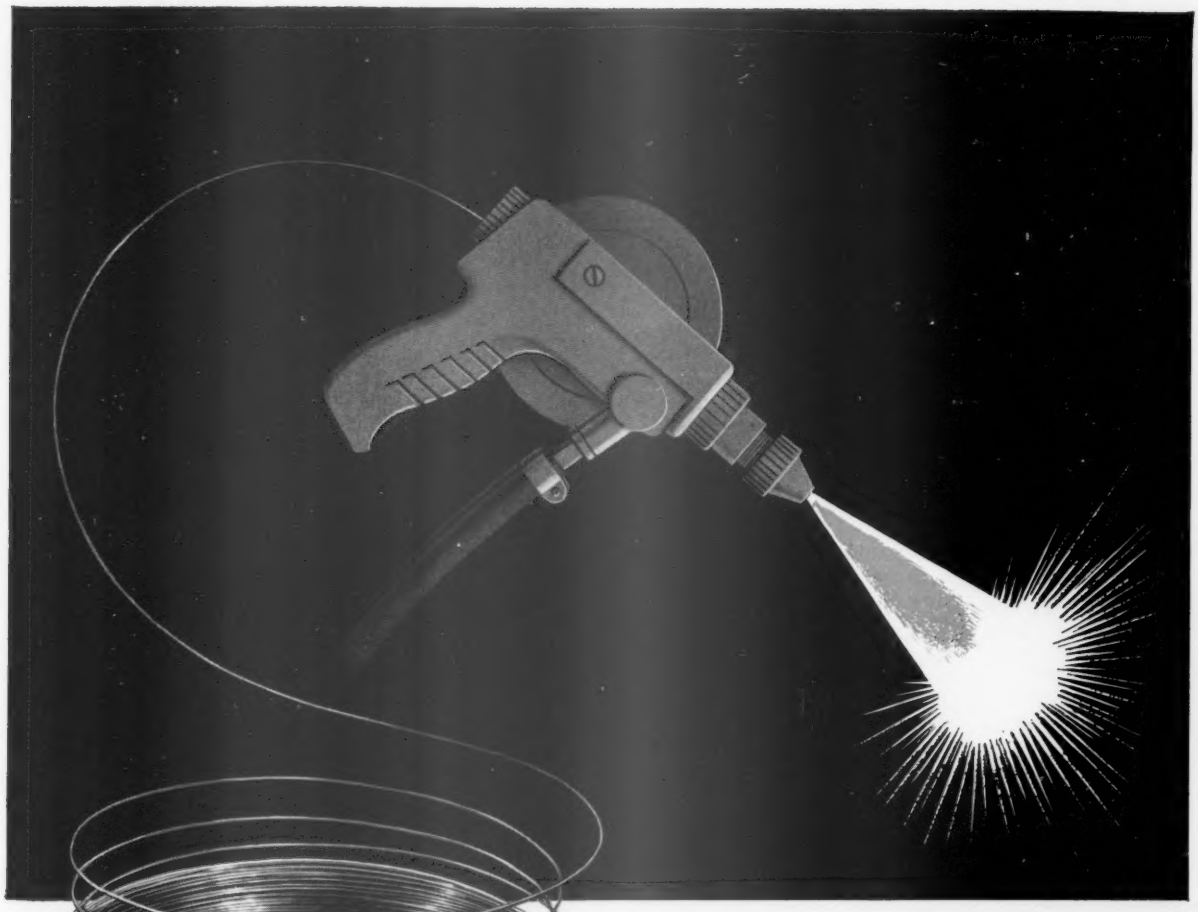
MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES



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With the right materials, metalizing or spray wire can be a tremendously successful production and maintenance operation. When metalizing aluminum, for example, efficiency and productivity go way up when gun feeds rich, pure United Aluminum Wire.

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U.S.I. POLYETHYLENE PROCESSING TIPS

Vol. II, No. 1

WITH MORE TYPES THAN EVER, HERE'S HELP IN CHOOSING THE RIGHT POLYETHYLENE FOR YOU

In the last year polyethylene has become a whole family of resins with a wide range of properties and many new use possibilities.

Today manufacturers are learning how to tailor polyethylene to almost any end use and processing condition by varying three basic characteristics of the resin in the original manufacturing process:

(1) *Density*
(2) *Molecular Weight*
(3) *Molecular Weight Distribution*

The properties of polyethylene, whether made by a high pressure, modified high pressure, or any of the low pressure processes are fixed by *all three* of these characteristics. An extremely large number of resins having markedly different properties can be produced by controlling these fundamental characteristics.

The processor can usually describe the properties he needs and the manufacturer can then determine which resin is most likely to fill the bill. From that point the two can work together to determine the "ideal" resin for the application.

The following chart shows in very general terms how some of the polymer properties are affected as these characteristics are varied.

Figure I: How Properties Change With Molecular Characteristics

PROPERTY OF POLYETHYLENE	CHARACTERISTIC		
	Increasing Density	Increasing Mol. Wt.	Widening M.W.Dist.
Stiffness	increases	increases slightly	increases slightly
Tensile Yield Point	increases	little or no effect	little or no effect
Film Brittleness	increases	decreases	increases
Softening Point	increases	increases	decreases
Low Temperature Brittleness	decreases	decreases	increases
Resistance to Environmental Stress Cracking	decreases	increases	decreases
Permeability	decreases	little or no effect	little or no effect
Tear Strength (Elmendorf)	decreases	increases	increases
Impact Strength	decreases	increases	—

Effects of Density Variations

The term density describes the weight per unit volume of the resin, and is influenced by the amount of branching in the molecule. Densities can range from 0.910 to 0.965.

The effect of density variations on polyethylene properties will be discussed completely in the next issue of "Polyethylene Processing Tips". You may receive your copy by mail simply by requesting it.

Effects of Molecular Weight

The term molecular weight when applied to polyethylene describes the average or mean size of the molecules in the resin.

Melt index has been used to indicate molecular weight in the past, but since it is also affected by the degree of branching of the molecules, it is a close, but not a completely reliable guide. In these discussions, therefore, we will refer to molecular weight rather than to melt index.

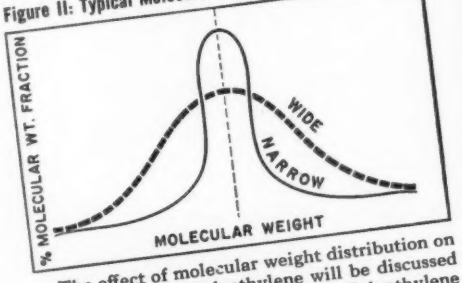
The effect of molecular weight variations on polyethylene properties will be discussed completely in a future issue of "Polyethylene Processing Tips".

Effects of M.W. Distribution

Distribution is determined by measuring how many of each size of molecule is present. When the percentage of each size of molecule is plotted against molecular weight, a distribution curve similar to the one shown below is obtained.

The shape of the curve for each resin tells whether the distribution is wide or narrow.

Figure II: Typical Molecular Weight Distribution Curves



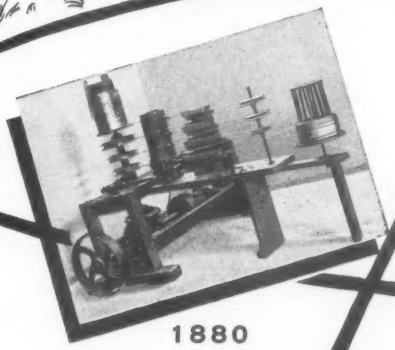
The effect of molecular weight distribution on the properties of polyethylene will be discussed completely in a future issue of "Polyethylene Processing Tips".

U.S.I. Offers Technical Assistance

By indicating density, molecular weight and molecular weight distribution — or preferably by indicating the properties you want in your fabricated polyethylene product — you will be able to obtain from U.S.I. a polyethylene resin specific to your end use. Our technical service engineers will be glad to discuss your requirements with you.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.

HERBORN

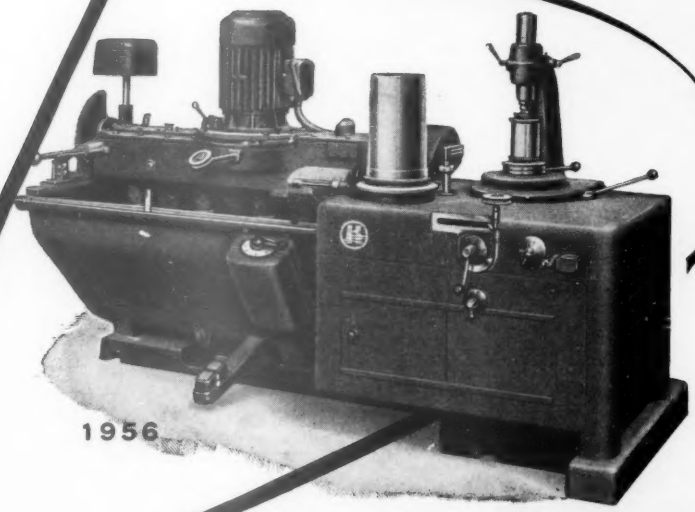


1880

A Long Way

leads from the
first wet-drawing machine

to the modern
High-Production
Multiple Wire
Drawing Machines
Operating under
the "HERBORN"
Submerged System



1956

The Invention and
Development of the "Submerged
System" Wire Drawing Machines
is inseparably connected with
the name "HERBORN."

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Sole Representative in the U. S. A.:

KURT ORBAN CO., Inc., 34 Exchange Place, JERSEY CITY 2, N. J.

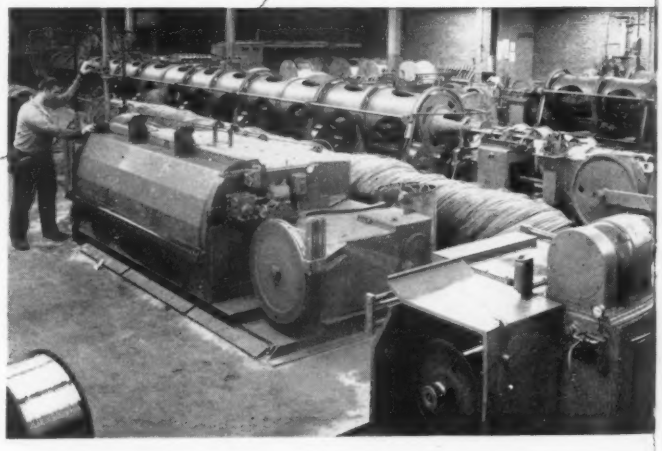
There's a Tale attached to Ben Franklin's Kite

It's a tale of wire — a long, long tale — the story of the billions of miles of wire that now transmit electricity all over the globe. This world of wire is SYNCRO's world, too, for SYNCRO machines are at work everywhere.

However, although SYNCRO machines are intercontinental citizens, all of SYNCRO's business is really local, because each wire manufacturer has his particular requirements and problems, providing fresh challenges to SYNCRO's designing and engineering ability. Solving these problems keeps SYNCRO on top, because building better machines brings satisfied customers. SYNCRO designers, engineers and craftsmen are never satisfied!

Superiority of design and manufacture, plus economy in performance are the acknowledged SYNCRO trademarks of quality.

Look first to SYNCRO'S experience for smooth performance, high profits.



SYNCRO MACHINE COMPANY

Perth Amboy, New Jersey, U.S.A.

affiliated company: WINGET SYNCRO Ltd. Rochester Kent, England

Better Machinery for the Wire Industry

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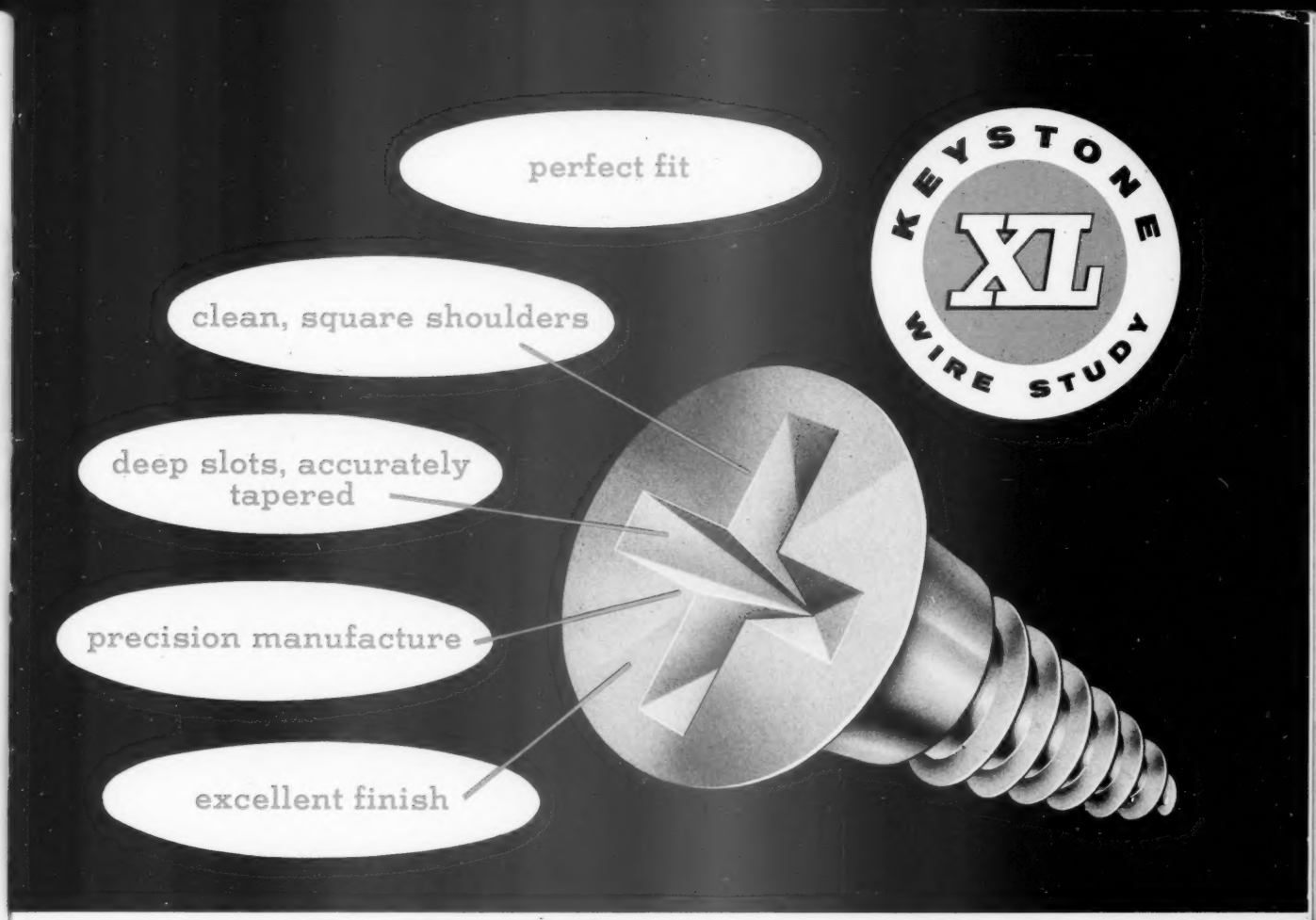
WIRE DRAWING MACHINES • DIE STRINGERS • CONTINUOUS ELECTRIC ANNEALERS • PAYOFFS • CAPSTANS • WIRE INSULATORS • HEAVY DUTY TAKEUPS • TAPERS • SPECIAL MACHINERY



KEYSTONE "XL" *flowability* is the secret for Reed & Prince Mfg. Co., Worcester, Mass.

Reed & Prince Mfg. Company has been producing many complex cold headed parts since 1886. This progressive firm has found that Keystone "XL" Heading Wire successfully fulfills difficult cold upsetting requirements with substantial savings in time and costs, with longer die life and fewer rejects.

Result: They make longer runs of quality fasteners, like the specially designed Reed & Prince Recessed Head Screw shown above, at lowest possible costs. The flowability of the wire is a prime factor in the manufacture of this precision recessed head screw. Deep, accurately tapered slots with clean, square shoulders provide a perfect fit for the Reed & Prince driver. The surface finish of Keystone "XL" Wire assures excellent plating qualities.

Take a tip from Reed & Prince: If you are having trouble heading complicated parts, talk it over with your Keystone representative. He will gladly help you analyze your wire needs. And if you are presently machining many complex parts, it may pay you to discuss your requirements with a manufacturer of cold headed products. We will gladly give you the names of Keystone "XL" Heading Wire users.

Keystone Steel & Wire Company, Peoria 7, Illinois

KEYSTONE
WIRE FOR INDUSTRY

Brand New...
COLD HEADING FACTS FOLDER
. . . send coupon today!

New folder discusses uses, applications, methods, technical facts, wire requirements.

Name_____ Title_____
Company_____
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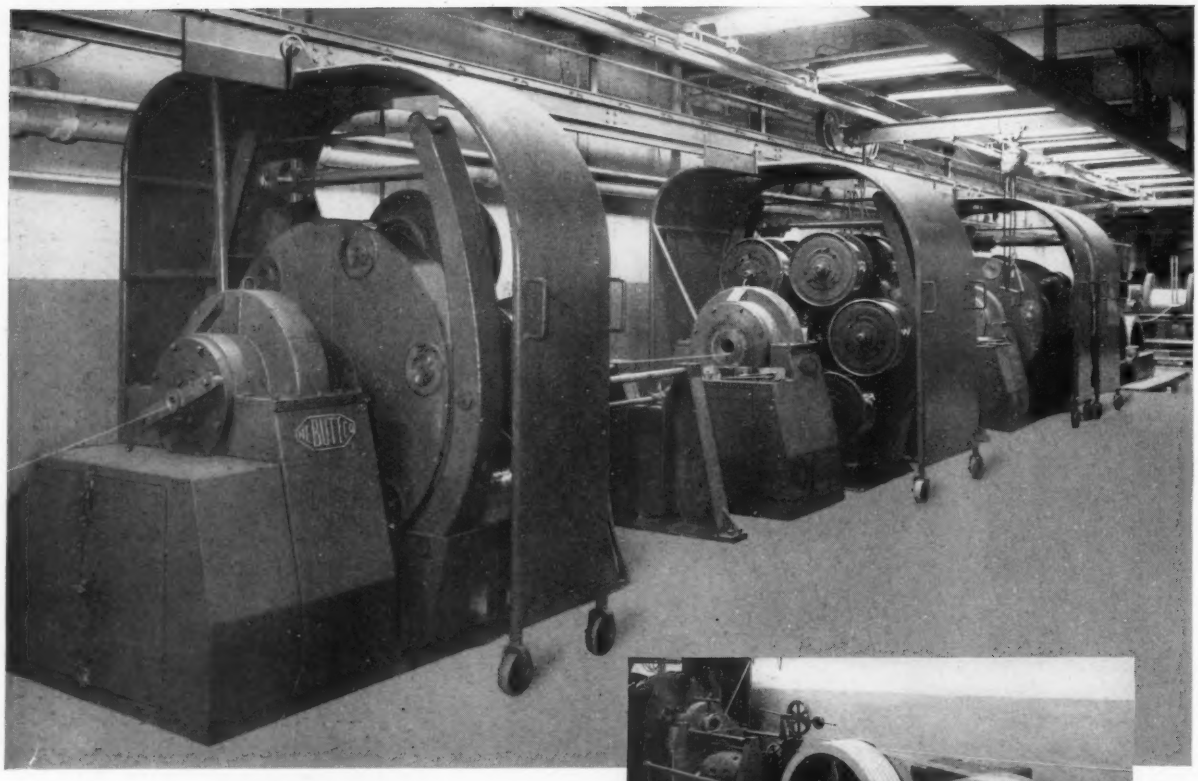

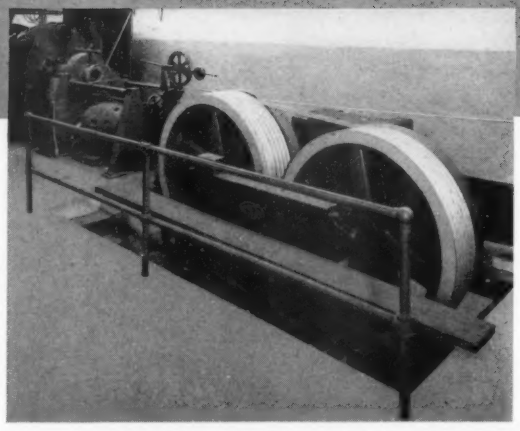

60" multi-groove capstans tilted for straight pull on cable without chafing. Both capstans are driven.

NEBUTTCO

RIGID STRANDER

Engineered with more than a century's manufacturing experience and ruggedly built for continuous, profitable operation, this high speed Strander requires minimum maintenance and produces high quality, uniform cables. All gearing is enclosed and guards are furnished as shown. The Strander is provided throughout with anti-friction bearings.

This machine has a capacity up to 37 wires and is supplied with 6, 12, and 18-reel heads. Any combination of spool heads can be supplied. Reels 22" diameter x 11" traverse are accommodated. Each head can be run independently in either direction or all heads can be run in unison in either direction at speeds up to 100 rpm. A speed of 120 rpm can be maintained on the 6-reel head. (150 rpm for aluminum).

For complete information and prices, contact New England Butt Company, 304 Pearl Street, Providence 7, R. I. or James Day (Machinery) Ltd., 28 Maddox Street, London W-1, England.

NEBUTTCO

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CABLERS · TAKE-UPS
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FORMVAR® . . .
for a balance of properties

You get more for your magnet wire dollar when you buy wire coated with FORMVAR phenolic enamel. You get a balance of mechanical, electrical and chemical properties unequalled in the industry . . . plus more than 15 years of proven performance as the industry standard. That's why FORMVAR phenolic enamel is used on more than 70% of all magnet wire.

FORMVAR phenolic enamelled wire possesses excellent wet and dry dielectric properties, exceptional adherence, flexibility and elongation, and outstanding resistance to heat shock, abrasion, solvents, acids and bases.

FORMVAR is the registered trademark for polyvinyl formal produced and sold only by Shawinigan Resins Corporation. When combined with an alkyl phenolic resin it becomes that tough, heat resistant wire enamel you may know as FORMVAR enamel.

If you want an insulation which will permit trouble-free service, lower maintenance and production costs, and greater efficiency, look to FORMVAR. Shawinigan's exacting production controls and active applications research keep FORMVAR a uniform and dependable ingredient for magnet wire enamels. Shawinigan Resins Corporation, Department 5305, Springfield 1, Mass.

FORMVAR® polyvinyl formal

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SHAWINIGAN RESINS

WIRE MANUFACTURERS...

Coulter & McKenzie
Draw-Pak
Model 227 shown

CUT PRODUCTION COSTS, INCREASE SALES WITH

Jal-Pak

THE NEW *SERVICE-PROVED* J&L WIRE PAIL

Count these J&L Jal-Pak advantages that add up to customer satisfaction and increased sales for you:

- Advanced design featuring a rolled smooth side seam available only in J&L Jal-Pak
- Protection in shipment and storage that only steel can offer
- Smooth interior surfaces that prevent damage to wire
- Rigid cylindrical cores of steel or fiber for trouble-free packaging and dispensing
- Lower investment—no deposit—no return
- Colorful decorations that "sell" wherever your product is seen

Jal-Pak Wire Pails are designed with your production problems in mind. Jal-Pak is a natural receptacle for use in line. It is easily adapted to any reel-type winding machine—single or multiple head—and saves you money through:

- Reduced downtime—no rethreading, replacing or rejoining is necessary
- Optimum winding speeds for the wire producer due to longer continuous lengths in Jal-Pak
- Increased productivity of men on the line
- Reduced in-plant handling operations

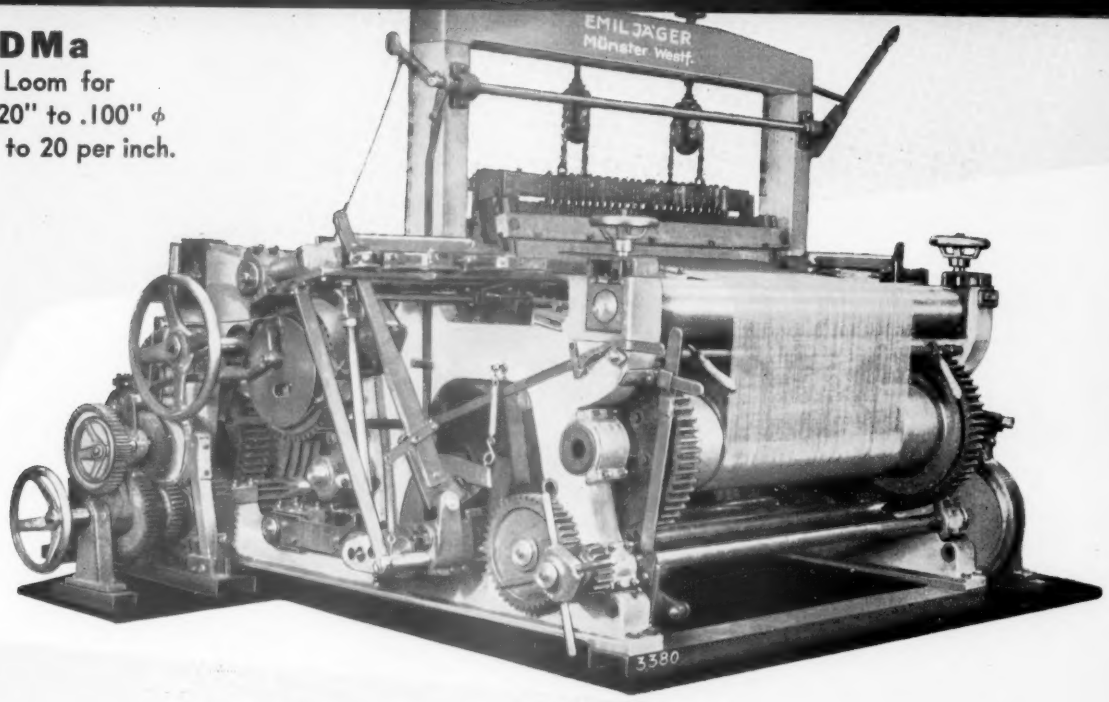
Jal-Pak Wire Pails are suitable containers for most types of wire including brass, copper, steel, aluminum, stainless steel, alloys and resistance, welding and soldering.

You can start packaging your wire in Jal-Pak *now*. Quotations will be made immediately. Delivery is guaranteed in two weeks.

For complete information on how Jal-Pak can increase production and sell more wire for you, contact your nearest J&L representative or write direct to our Container Division.

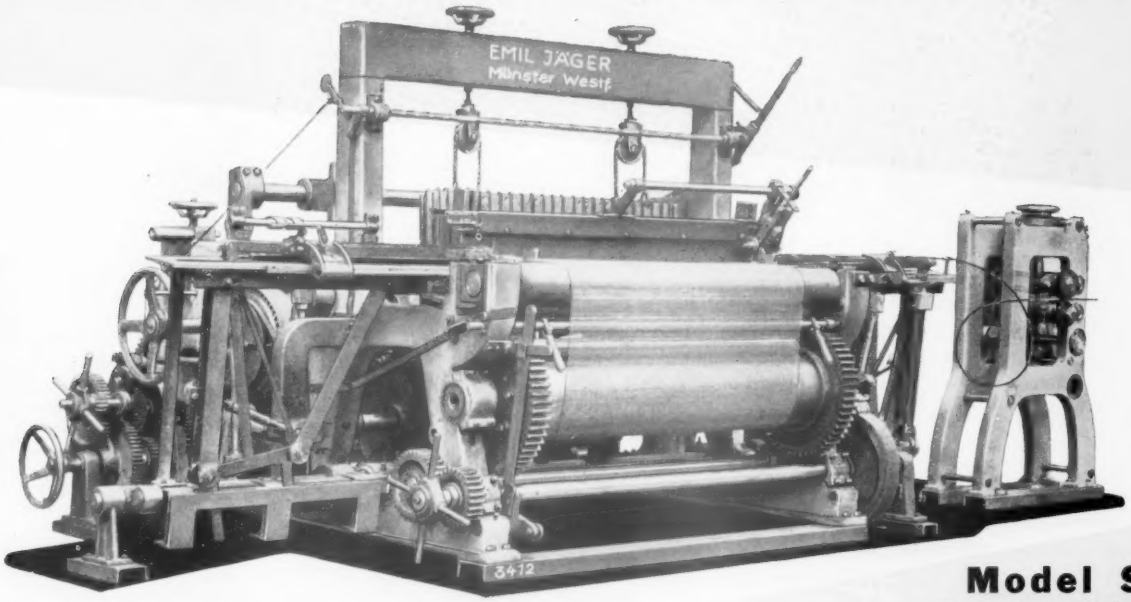
Jones & Laughlin
STEEL CORPORATION · PITTSBURGH
Container Division
405 Lexington Avenue, New York 17, N. Y.

Model DMa
a Fly-Shuttle Loom for
wires from .020" to .100" ϕ
and meshes 1 to 20 per inch.



JAEGER

Wire Weaving Looms—Weaving width 40 to 80 inches



Model St-DMa
with Positive Pick-Arm Device
and synchronized Crimping Machine to
feed pre-crimped shoot wire direct from
crimper automatically into the shed of the loom
For high tensile wires from .020" to .100" diameter

Sole Representatives for U. S. A. and Canada

CEDAR-WEST TOOL COMPANY, INC.

Tel.: REctor 2-1520 **88-90 West Street • New York 6, N. Y.**

Brush wire, crimped (as shown) or straight, now produced in multiple strand, and furnished in coils or straight hanks depending on wire size.

How a **new idea in wire** *cleaned up a brush production problem*

• Maybe you can profit by the kind of interest and action applied to customers' problems by the Worcester Wire Works Division of National-Standard. Take wire brush manufacture for example . . .

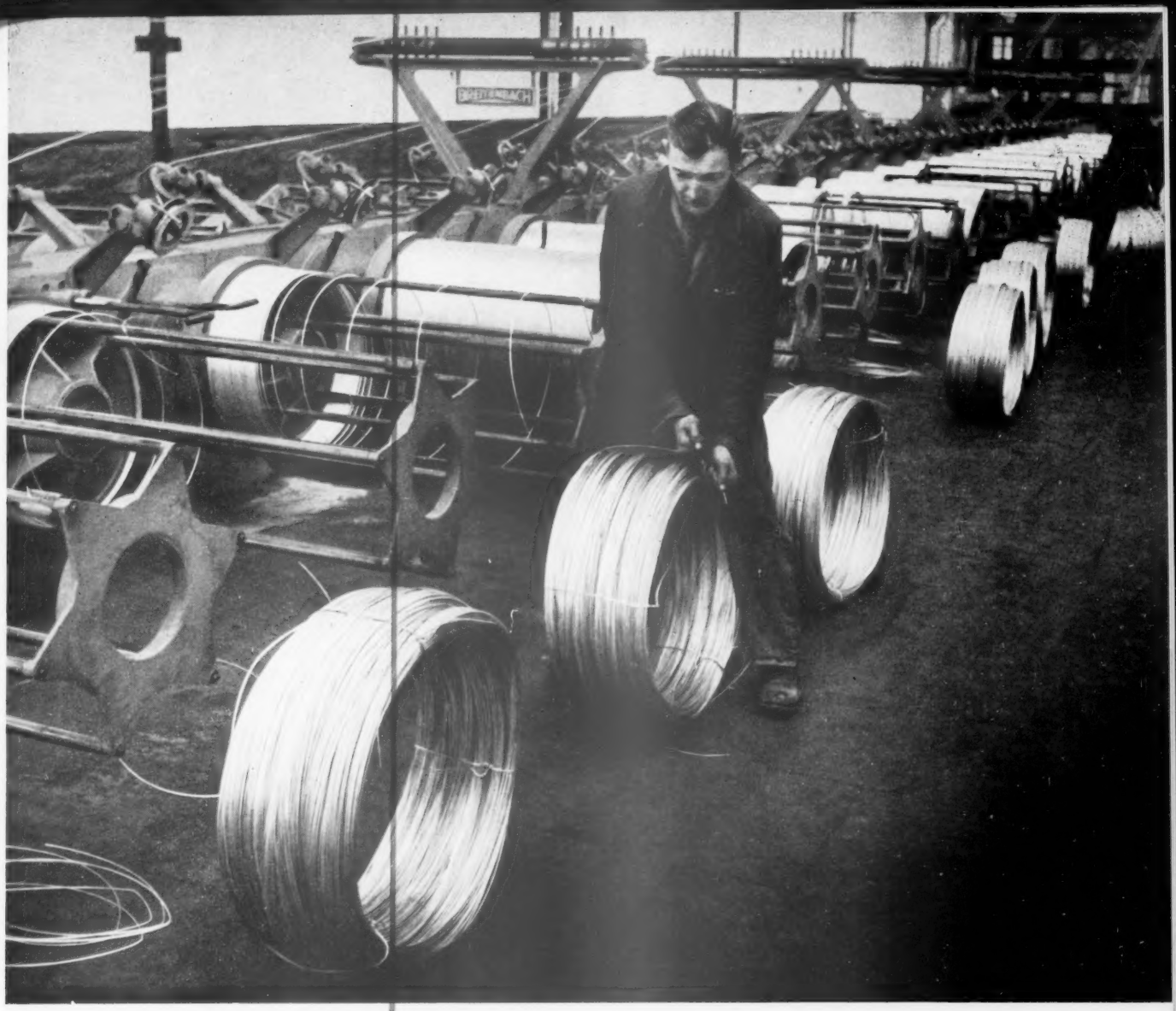
Until recently, brush manufacturers had to cut through a coil of wire, then gather by hand and by guesswork the approximate number of wires for the type of brush in production. Naturally this involved a lot of cut-off waste, plus the wire lost through faulty guesswork.

Now, to overcome this waste, Worcester Wire Works has developed ways to produce and furnish wire in predetermined bunches (up to 400 wires per bunch) with *exactly* the right number of wires for a given brush. Much costly loss is eliminated, more brushes are produced per pound of wire, and production is speeded.

The point is, Worcester Wire Works people specialize in more than quality wire. They also specialize in the kind of service and exploration that time and again cuts costs for customers. Better check with them on your wire needs. You'll like the way they do business.

NATIONAL NS NATIONAL-STANDARD Company NILES, MICHIGAN **STANDARD**

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; *tire wire, stainless, music spring and plated wires* • **WORCESTER WIRE WORKS, Worcester, Mass.;** *high and low carbon specialty wires*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • **ATHENIA STEEL, Clifton, N. J.;** *flat, high carbon spring steels* • **REYNOLDS WIRE, Dixon, Ill.;** *industrial wire cloth*



Take Up Frame for galvanised and patented wires
with stationary blocks or convertible to rotating action

WILHELM BREITENBACH
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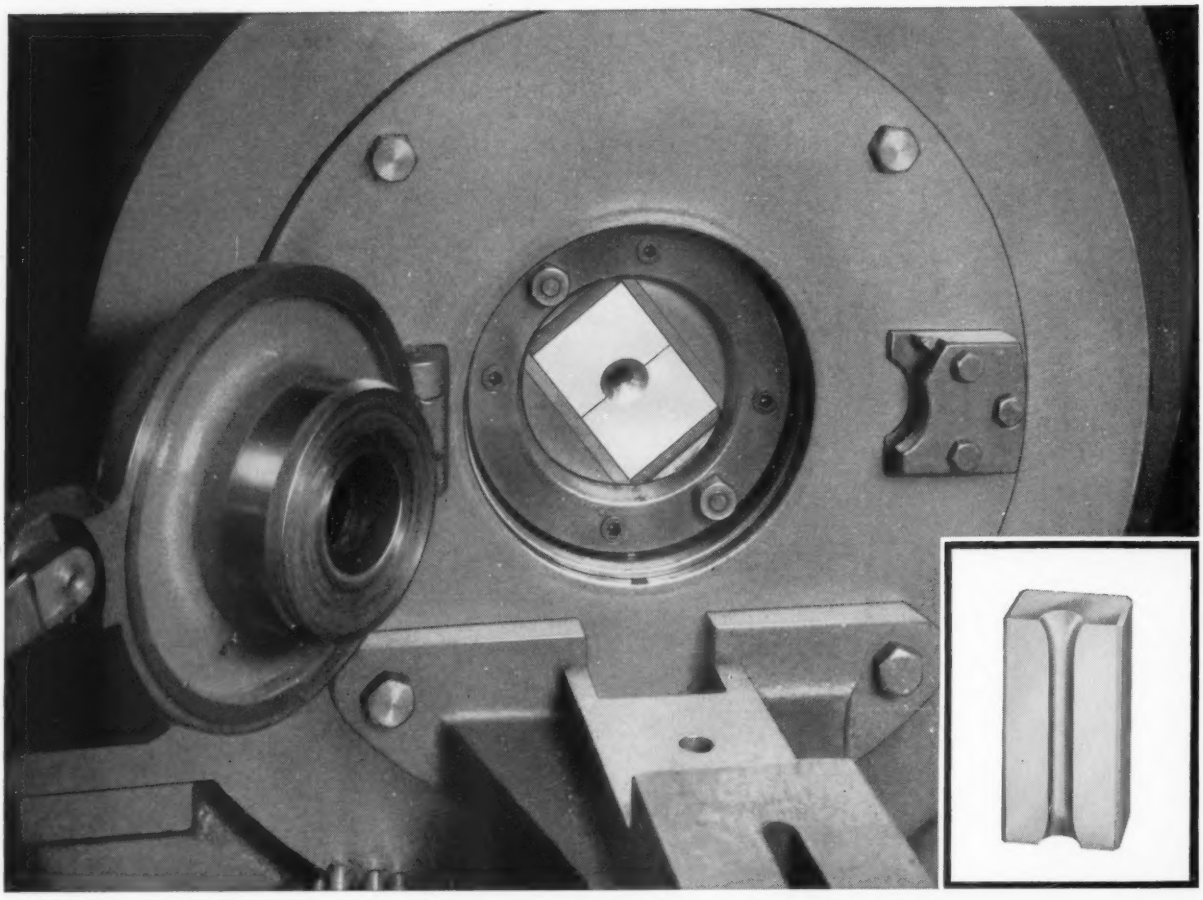
BREITENBACH · UNNA



KENNAMETAL* Dies swage up to 50 times more pieces than steel

with more accurate dimensions and better quality

By switching to dies made of Kennametal Grade K90, a manufacturer of hand tools has obtained these important benefits on a hot swaging operation:

- increased production of swaged steel alloy rods from 100 to 1000 pieces between dressings . . . machine down time greatly reduced.
- swaged pieces are now more uniform and of better quality.
- the Kennametal dies are outlasting the steel dies 30 to 50 times.

Although the Kennametal die blocks cost about five times more than the steel dies previously used, they quickly pay for themselves and show substantial profits on the investment.

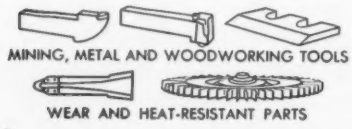
As Kennametal dies and die sections are showing similar results on many types of operations, why not select Kennametal for your next die parts . . . for blanking, compacting, cold heading, cupping, drawing, forming, perforating, piercing, slitting, stamping or swaging.

You can choose from Kennametal's "90 Series" with six grades or the exclusive non-galling "80 Series" with three grades. These grades provide a range of carbides that meet the specific requirements of any die application.

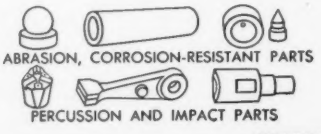
A Kennametal die engineer will gladly work with you or your die maker in applying the right grade of Kennametal for your dies. Call him at your nearest Kennametal office or write to KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

B-5948



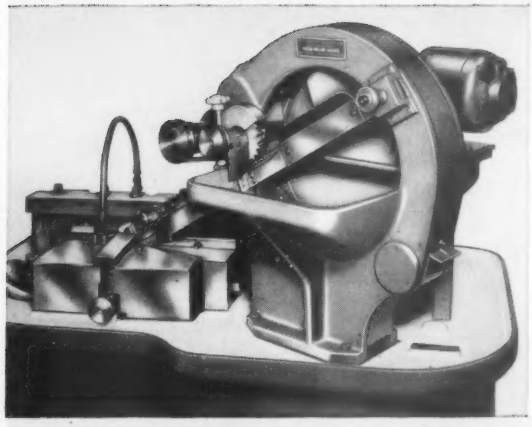
INDUSTRY AND KENNAMETAL ...Partners in Progress



SCREWS or NAILS THREADED

with Hartford Special Automatic Thread Rollers

- **Diameters from .086 to .3125"**
- **Thread lengths from ⅛ to 2½"**
- **Large capacity hopper reduces refill time**
- **Positive positioning and feeding of blanks**
- **Variable bucket speeds**
- **Roll Class 3 Thread Fits**
- **Wired to J.I.C. Standards**



SPECIFICATIONS
MODEL A-190-R

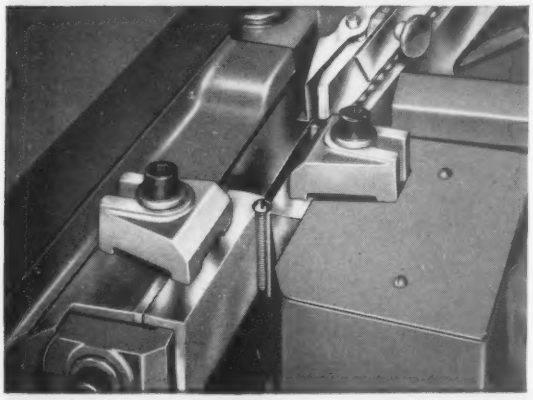
Screw Diameter Capacity: Machine Screw Sizes from #2 (.086) to #10 (.190)

Thread Length Capacity: ⅛" to 1½" with standard depth dies; 2" with special depth dies

Production Rate: 230 to 250 pieces per minute

Machine Dimensions: Length, 42"; Width, 26"; Height to table, 33"; Height overall, 52"

Floor Space Required: 4' x 5' approximately



SPECIFICATIONS
MODEL A-312-H

Screw Diameter Capacity: Machine Screw Size #6 (.138) to 5/16"

Thread Length Capacity: ⅛" to 2" with standard depth dies; 2½" with special depth dies

Production Rate: 80, 100, 120 or 140 pieces per minute dependent on screw size

Machine Dimensions: Length, 62"; Width, 39½"; Table Height, 36"; Overall Height, 63½"; Hopper Loading Height, 53"

Floor Space Required: 4'x6', approximately

Hartford's line of automatic Thread Rollers can accommodate all types of machine screws, sheet metal screws, drive screws, wood screws, nails and screwnails. They will also knurl, burnish or groove, and can handle specials as well.

These high production machines are equipped with a filtered lubrication system. They are vibration-free even at top speed. They are ruggedly designed, and engineered to provide "table-top" working level to reduce operator fatigue.

Write for Bulletin TR-102 for complete information.

Hartford Special also makes Drilling and Tapping Machines, Machine Components, Special Machines and the world famous Super-Spacer.

HARTFORD Special

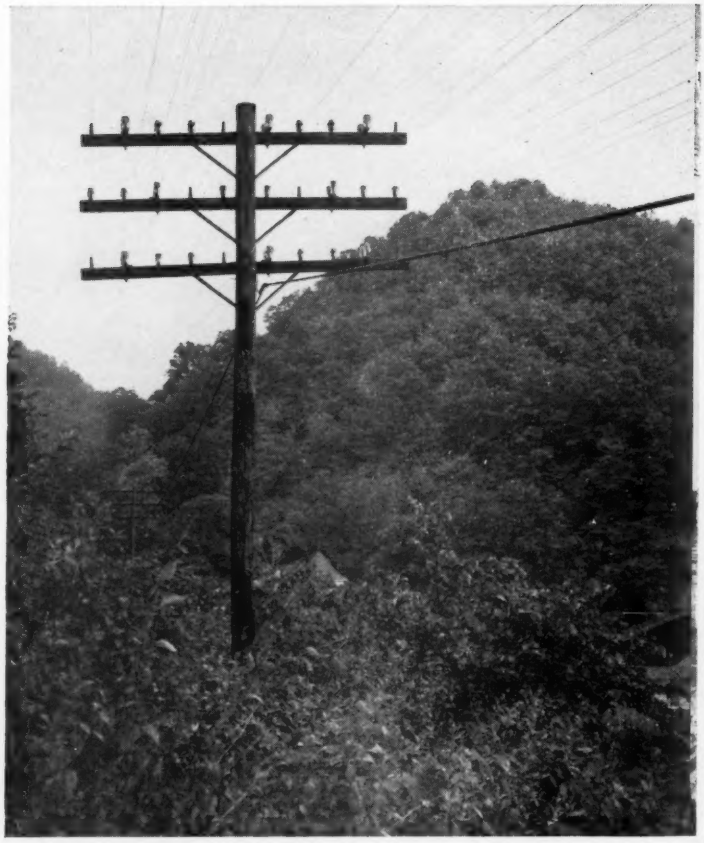
MACHINE TOOL ACCESSORIES DIVISION
THE HARTFORD SPECIAL MACHINERY CO.
2525 HOMESTEAD AVENUE HARTFORD 12, CONN.

Telephone installations show . . .

Where Polyethylene brings savings

INDIANA—A substantial saving in poles is evident in this rural area. The light weight of cable covered with polyethylene permits smaller poles, longer spans, faster installations. In many cases, cable can be strung without a messenger. Splicing has been greatly simplified.

The polyethylene covering has been found highly resistant to ice formation during the sleet storms common to northern Indiana. Where underground installations are made, polyethylene has eliminated the problem of electrolytic action in the soil. Installations in the near future will have much of this cable plowed underground, at a considerable saving.



WEST VIRGINIA—Installation of additional lines here in the mountains is a costly undertaking. Steep slopes overgrown with trees and brush make rights-of-way practically inaccessible to motorized equipment. In addition, holes for poles must often be blasted through rock.

Most of these problems are solved by distribution wire covered with lightweight polyethylene, now used almost exclusively in this area. This cable can be strung on existing poles, often without adding crossarms. Where lines are strung along railroads and near coal preparation plants, the chemical-resistant polyethylene promises protection from chemical fumes.

These field reports from the telephone industry may help you evaluate the economies possible with polyethylene-insulated cable in your own installations. Taken together, they represent many years of experience with BAKELITE Brand Polyethylene under a variety of terrain and climatic conditions.

The light weight of this insulation has saved time and effort in installation; in fact, some installations would have been next to impossible with earlier materials. The moisture resistance of polyethylene has minimized weather hazards, while dielectric strength has far exceeded telephone requirements. The strength and flexibility of polyethylene have simplified cable handling.

In addition to telephone applications, BAKELITE Polyethylene is extensively used in utility line wire and service drop, power cable, coaxial cable, and signal control cable. Besides satisfying REA requirements for plastic-covered telephone wire, it meets applicable IPCEA specifications for power cable, ASA standards for weatherproof wire, ASTM D1238-52T Type II, dielectric materials, and IMSA specifications for fire alarm and signal control cable. For more information, write Dept. RH-196.

BAKELITE
BRAND
Polyethylene Plastic

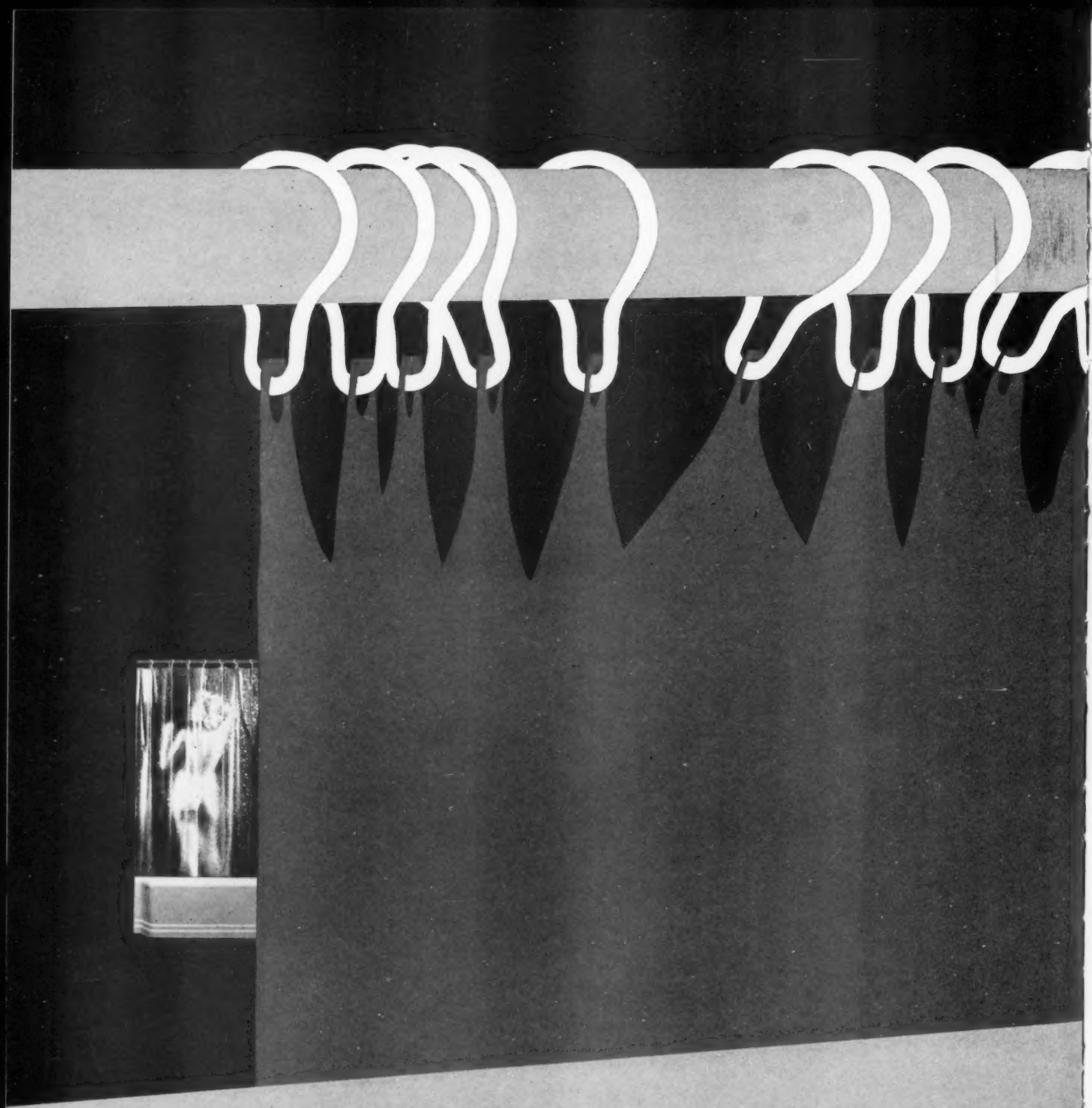
BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario
The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

TEXAS—These parallel telephone lines illustrate the savings possible with polyethylene-covered cable. Here, the new lines require ⅓ fewer poles as a result of the extremely light weight of the polyethylene.

Over a million pair-feet of polyethylene-covered cable are in service, and 70 million more are on order for this section, where climate ranges from semi-tropic to semi-desert. The polyethylene jacket must withstand heat, cold, wind, icy and arid conditions. When cable is placed underground, as in urban areas, the polyethylene resists corrosion by stray electric currents in the earth.

VIRGINIA—This terrain combines steep slopes and meadowland, much of it covered by sharp rocks. Problems include the difficulty of placing poles, the need to use only "overhead" rights-of-way at many points, and possible damage to ordinary cable covering if it comes into contact with the stony ground.

Under these circumstances, the lighter, tougher, more flexible polyethylene-covered cable was a distinct advantage. It permitted longer spans to stretch from hill to hill without poles in the fields. It was strung through blocks on the messenger in sections impassable to trucks. There was never any danger of its sagging to the ground and being cut on the rocks.



a profitable idea!

These curtain hooks are fabricated on a four-slide machine from Alcoa® Aluminum Wire . . . light, strong, rustproof. They're good looking, can be anodized in blue, gold—various colors. If you use wire in your product, check into the many advantages of aluminum.

Alcoa has set up a special department to work with you on profitable new ideas, new uses for aluminum wire. For immediate action, write ALUMINUM COMPANY OF AMERICA, Wire Products Development, 875-E Alcoa Bldg., Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM WIRE PRODUCTS

THE ALCOA HOUR • Television's Finest Live Drama • Alternate Sunday Evenings

Naugatuck NAUGAPOL

SPECIALLY-PROCESSED BUTADIENE-STYRENE POLYMERS

dry!

...like the Moon

The Moon is dry because it has no atmosphere. NAUGAPOL® polymers are dry–*and stay dry*–because they are free of moisture-absorbing salts.

Special processing does it...special processing that eliminates use of salts as the coagulant. Whatever grade you require–1016, 1018*, 1019*, 1021, 1022*, 1023, 1503* or 1504*–the name NAUGAPOL is your assurance of–

- **HIGH DIELECTRIC PROPERTIES**
- **LOW MOISTURE ABSORPTION**
- **LOW ASH CONTENT**

These are the qualities that make NAUGAPOL Polymers ideal for use in electrical wire and cable insulation and in mechanical rubber products requiring good flexibility at sub-freezing temperatures. If *you* require *special properties* in synthetic rubber, come to Naugatuck!

*Light-colored polymers stabilized with non-discoloring, non-staining POLYGARD®

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

US RUBBER

IN CANADA: NAUGATUCK CHEMICALS, Elmira, Ontario • Cable Address: Rubexport, N. Y.
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices

Unretouched photograph of *Carboloy R-8 Wire Die*, used for drawing low-carbon steel at the Wyckoff Steel Company, New England Works. After producing 5,014,000 lbs. of wire in 14 years, the inside diameter has increased only .0037". (R-8 die shown 1⅓ times actual size.)

MORE THAN 5,000,000 LBS.
OF WIRE DRAWN DURING . . .

14 YEARS ON THE JOB . . . AND THIS CARBOLOY® DIE HAS CHANGED ONLY .0037"

This Carboloy R-8 die has drawn more than 2000 miles of wire since put in operation in 1942. Yet its inside diameter has changed only .0037" since it was purchased. What's more, the approach has never needed polishing; the wear ring has never needed removing.

This case history is one of the most spectacular in the history of carbide wire dies. But it is a typical example of the extra-long service life you can expect from every Carboloy die.

Equally important, you can depend on savings in grinding and downtime costs . . . longer production runs; smoother, more accurate wire.

Add in the other Carboloy "bonuses" for wire die users: immediate local delivery, on-the-job engineering service, wire-die training school for your personnel, and die servicing and finishing facilities. You'll see why more and more mills specify Carboloy carbide dies.

For engineering service, or your copy of the Carboloy Die Catalog and Service Manual, write: *Metallurgical Products Department of General Electric Company, 11171 E. 8 Mile Blvd., Detroit 32, Michigan.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

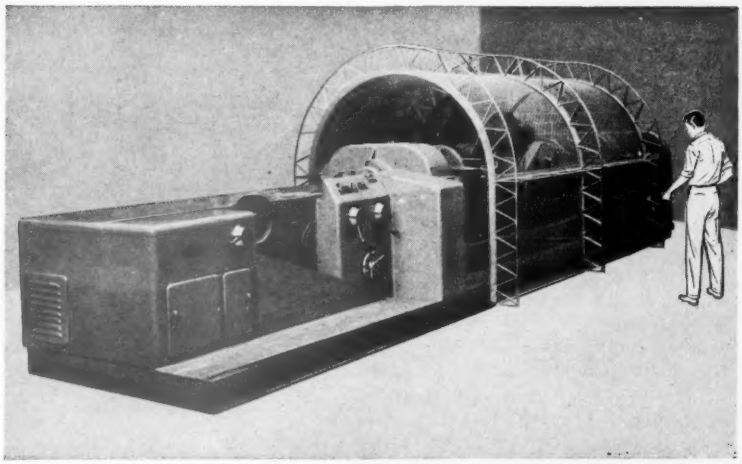
JEAN MARQUÈNE

PAY LESS

for stranding insulated wires !

Godderidge offers you a new

FLYER-STRANDER which makes it possible



OUTSTANDING FEATURES :

OUTPUT SPEED : 300 ft/min. for all lays.

GREATER LENGTHS : due to 40 inch/take-up reel.

SYMMETRY STRANDING guaranteed by a spécial device.

Number of conductors up to 4; max. cablediameter: 0,8 inch

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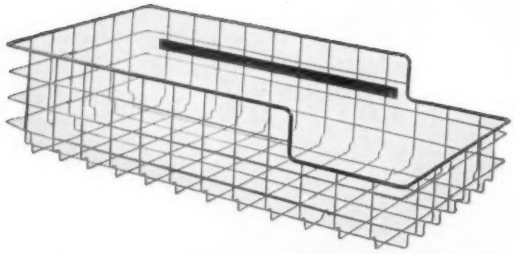
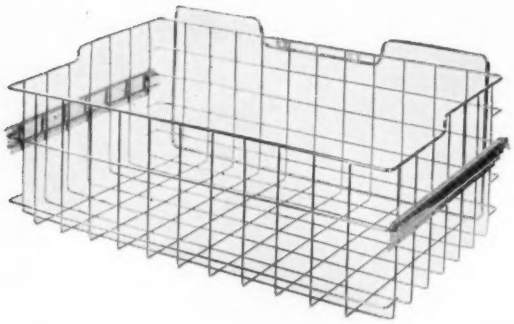




YOUNGSTOWN EXTRA SMOOTH CLEAN BRIGHT BASIC WIRE

Plus Automated Fabrication Techniques Gives High Quality Production to *Bauer* Brothers

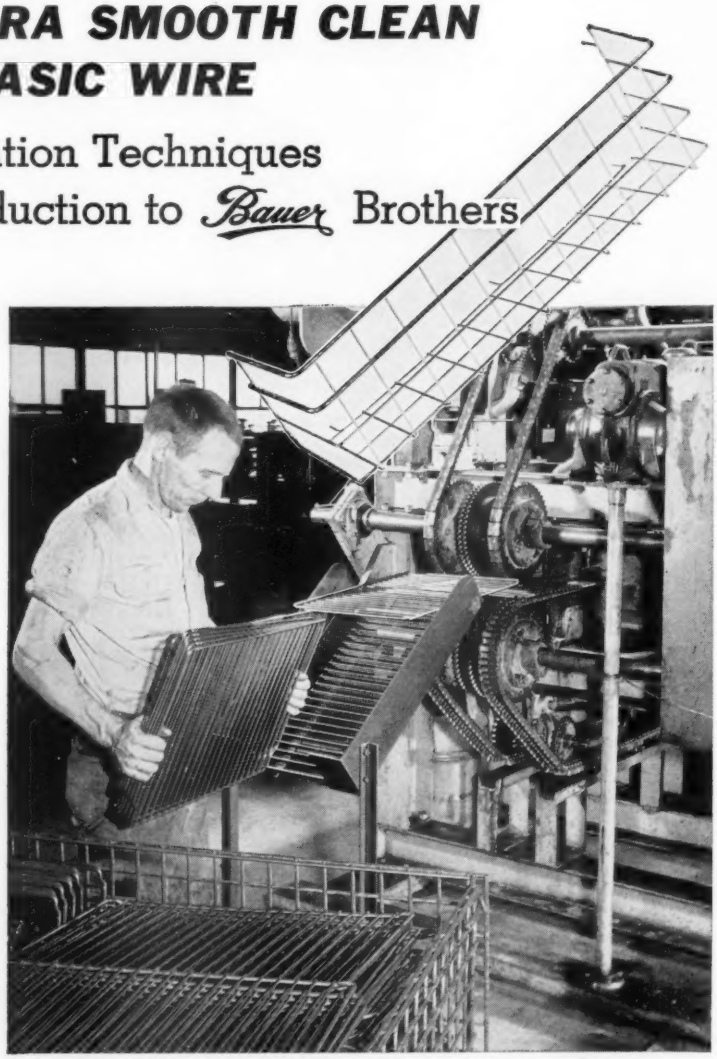
Over 75 years of production know-how combined with an excellent background of engineering experience enables the Bauer Brothers Co. of Springfield, Ohio, to provide their customers with economical, intelligent, up-to-the-minute wire product designs.

Using the latest techniques in "automation", this progressive fabricator relys on Youngstown's Extra Smooth Clean Bright Basic Industrial Quality Wire to keep both their production and product quality at a high level. They find it forms easily—while still providing the necessary rigidity and strength required in their finished products.

Its surface is free from all oil, dirt and grease which enables plating that's permanent—won't flake off. Also, it spot-welds fast and sure for permanent, strong construction. Why not make it your continuing specification for increased production and profits.

All Youngstown Wire is quality-controlled through each integrated operation from ore mining to final drawing. Thus, you can be sure there will be no injurious seams and piping, laps, die marks or internal tearing and cupping to hold up your production lines.

For additional information or metallurgical assistance, write or phone your nearest Youngstown District Sales Office today.



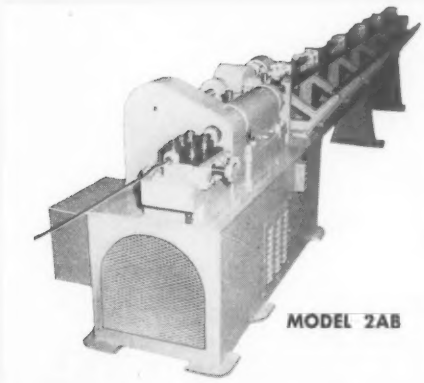
Bauer's "Flying Dutchman" using Youngstown Extra Smooth Clean Bright Basic Wire automatically fabricates a frame into a finished shelf in only 60 seconds.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

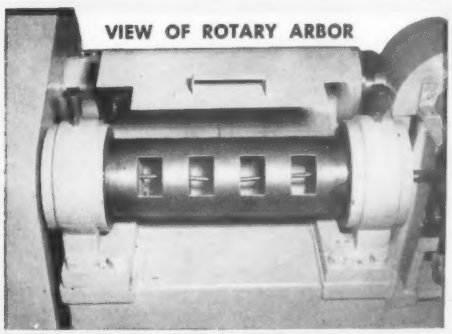
Manufacturers of Carbon, Alloy and Yoloy Steel
General Offices - Youngstown 1, Ohio
District Sales Offices in Principal Cities

SHUSTER

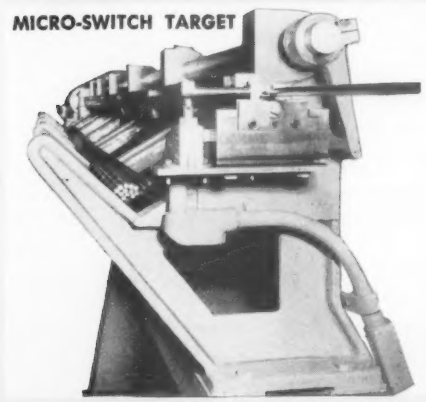
gives it to you STRAIGHT!



MODEL 2AB



VIEW OF ROTARY ARBOR



MICRO-SWITCH TARGET

SHUSTER automatic wire straightening and cut-off machines are designed for volume production, minimum down-time, and lowest operating and maintenance costs.

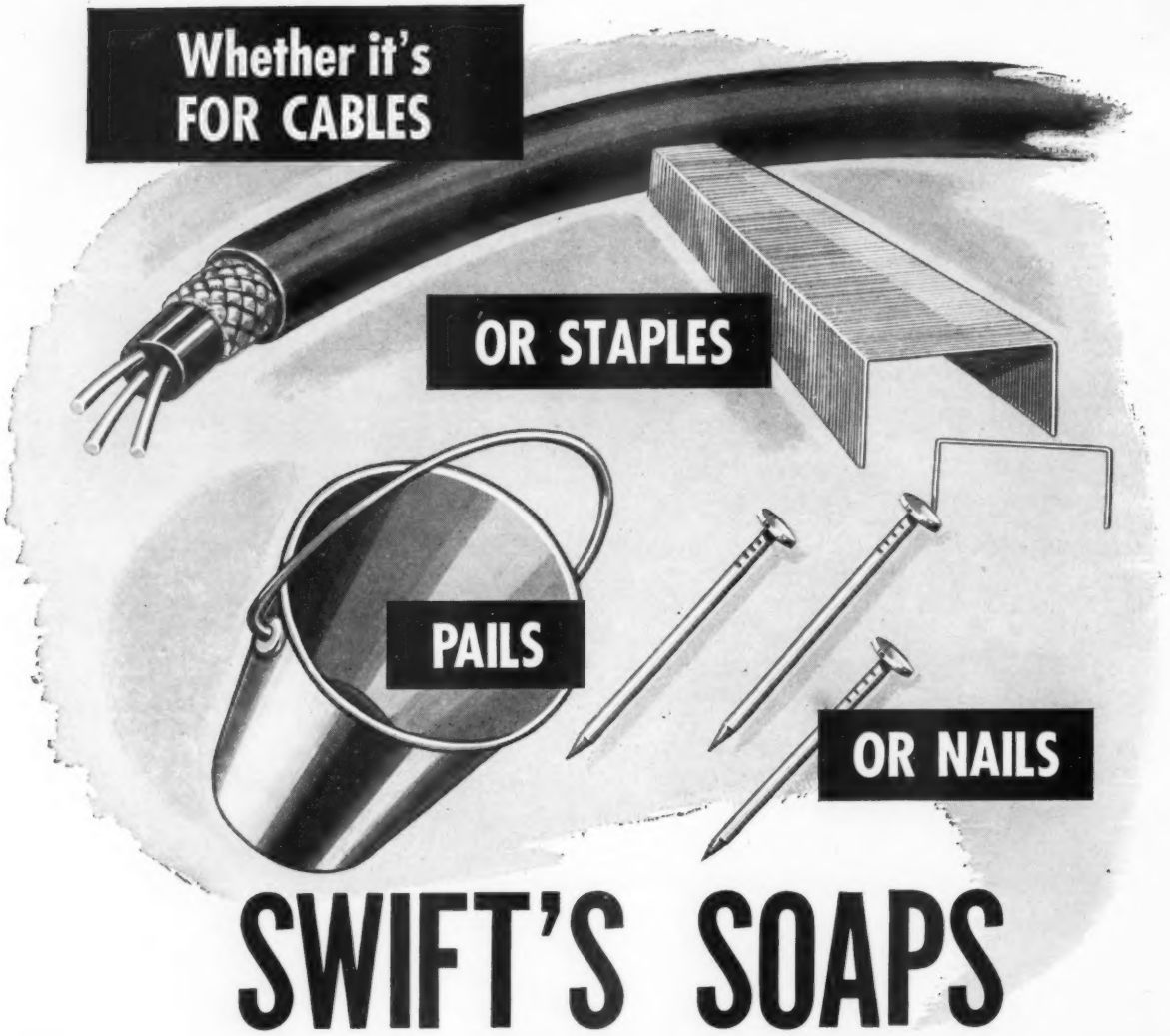
Here is the new constant speed Model 2AB, a rugged straightener for basic wire from 3/16″ to 3/8″. It provides instantaneous, *electrically* controlled cut-off, triggered by a positive release Micro-Switch target and solenoid clutch control. The operator merely locks the stoprod gauge for desired length of cut, and the machine delivers accurate, square-cut, lengths of wire throughout the production run.

May our engineers be of service to you? In addition to wire straightening and cutting equipment, for sizes from .025 to 11/16″ wire, SHUSTER products include slide feed straighteners, feed starters and straighteners, tube and bar straighteners, and wire reels.

Send for complete literature today to:

METTLER
MACHINE TOOL, INC.
150 Adeline Street, New Haven, Connecticut

send for free wall size split gauge wire chart from 41 gauge to 7/0



SWIFT'S SOAPS

STRATEGIC DISTRIBUTION POINTS throughout the U.S. and Canada can provide prompt, courteous service and immediate delivery on these versatile soaps:

WHITE RIBBON POWDER. White Ribbon Powder in the 41-42° titer range is used by many particular customers as an all-purpose wire drawing compound. Contains 92% anhydrous soap.

#571 HIGH TITER POWDER. A wire drawing powder for the difficult job. A neutral 93% soap powder in the titer range of 45-47° C.

#559 POWDER. For wet drawing of the fine wire products. In solution will remain fluid and completely free flowing at room temperature.

are the efficient lubricant for wire drawing

Whether the need be for cables, staples, pails, or nails an efficient wire lubricant is indispensable. That's why Swift's Soaps are constantly being improved to help give you brighter, smoother wire, increased production, and extended die life.

Yes, with any of the products listed at left, you need never compromise the efficiency and speed you purchased in wire drawing equipment. Write for details on these and other SWIFT quality wire lubricants and remember ... ONE TRIAL IS BETTER THAN A THOUSAND CLAIMS.

To Serve Your Industry Better

Swift
102 ND YEAR

SWIFT & COMPANY
SOAP DEPARTMENT
4115 Packers Ave., Chicago 9, Illinois

IF YOU MAKE *Springs*

YOU'LL DO BETTER WITH ROEBLING

ROEBLING makes high carbon steel spring wire and flat spring steel... and makes it *better*... for every sort of spring and for every product that requires spring characteristics. Hard drawn, hard rolled, annealed or soft, tempered or untempered ... they're all available to meet your requirements exactly.

Among these Roebling materials are zig-zag and no-sag wires; mechanical and valve spring wires; music wire; clock and motor type spring wires; flat spring steel and upholstery spring wire of all types. The variety of parts into which these are formed is almost endless, but manufacturers all report that Roebling quality and uniformity reduce machine downtime.

Learn for yourself how Roebling can help your production and product. John A. Roebling's Sons Corp., Trenton 2, N. J.

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

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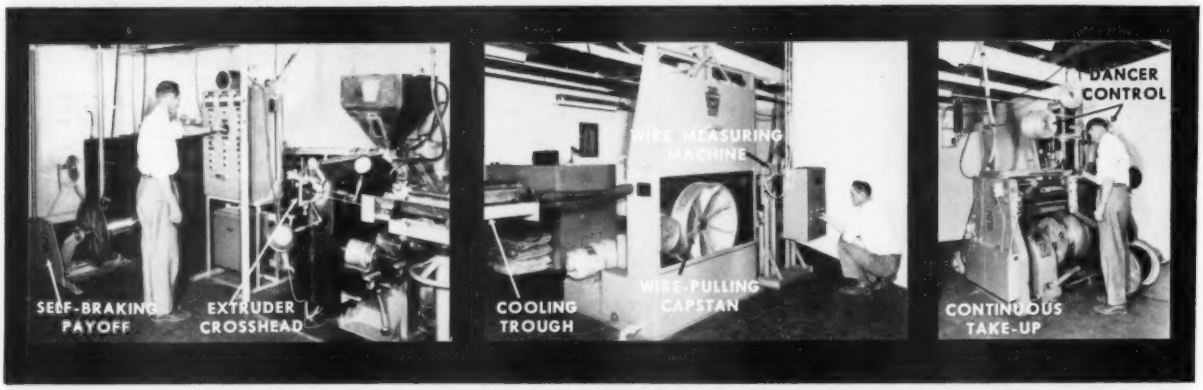
DAVIS-STANDARD'S

Testing Laboratory

IS READY TO HELP SOLVE YOUR EXTRUSION PROBLEM

A Complete Facility For Testing New Extrusion Methods, Materials and Machinery

Extruders and wire machinery from pay-off to take-up are in operation at Davis-Standard's Testing Laboratory to try new materials and develop new techniques. Skilled technicians set up and test-run sample jobs to determine extrudability of new compounds and to iron out problems peculiar to a customer's operation.



The Testing Laboratory is another reason why the name DAVIS-STANDARD means quality equipment.

Many successful new applications for extrusion equipment have been developed through experiment and research in the Davis-Standard Testing Lab in cooperation with representatives of industrial concerns. Optimum speed, cooling, head temperatures and feed factors can be resolved in the Lab to assure that each customer will receive the machinery best suited to his production requirements.

Research and development of new Davis-Standard machinery is a major function of the Testing Laboratory. It is here where all the "bugs" are worked out of new designs, and where prototypes are tried and proven before production models are made available to industry.

For further information write to:

DAVIS-STANDARD

Division of FRANKLIN RESEARCH CORPORATION

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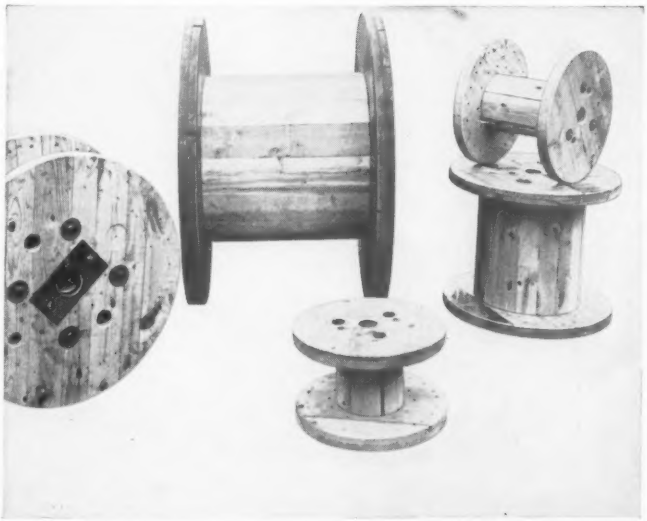
IN EUROPE AND THE STERLING AREA, CONTACT FINNEY PRESSES LTD., BIRMINGHAM, ENGLAND

SAVE with..

NON-RETURNABLE

WOOD shipping REELS...

for all sizes and types of Electric Wire and Cable



Look at these advantages:

- *Reduced Reel Investment*
- *Less Storage Space*
- *Lower Freight Costs*
- *No Repair Costs*
- *No Return Freight Costs*
- *No Bookkeeping*
- *No Cash Deposits Req'd.*
- *No More Headaches ! !*

NON-RETURNABLE REELS ALLOW DEFINITE PACKAGING COSTS.

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SHIPPING SERVICE in our... OWN TRUCKS

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels in 5 days or less east of the Mississippi.

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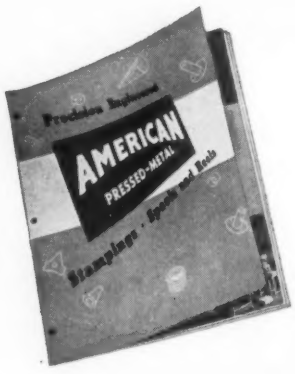
"REEL GOOD . . .

Let us quote on your reel needs. Send your specifications. Better yet, visit our plant and see how and why our reels are made so well at so low a cost.

WOOD REELS"



Send for your free copy of our latest bulletin on American Pressed-Metal Spools and Reels. It contains full details and charts on the many standard types.

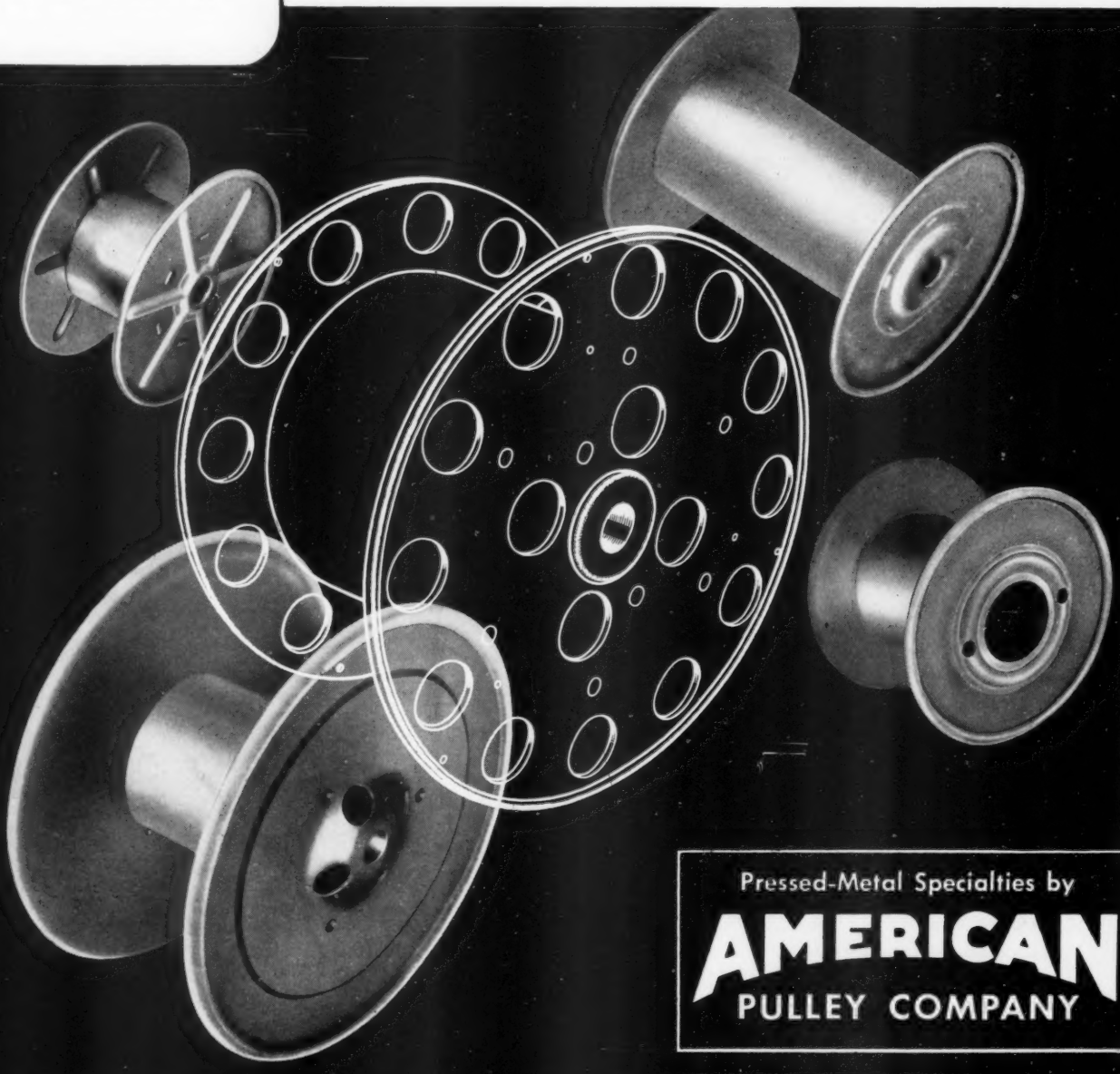
For shipping or processing spools and reels get exactly what you want from American Pulley

Name your need . . . there's an American pressed-metal reel or spool to meet it. And if our long list of standard sizes doesn't contain the model you need, we'll custom-build one to your exact requirements.

American pressed-metal spools and reels are practically indestructible—won't crack, chip or warp. They offer the added advantages of light weight, cleanliness and strength.

Almost 60 years' experience in design and manufacture—plus a vast assortment of tools, dies and other facilities for making all types of spools and reels to strict custom specifications—are at your service.

Send us your specifications, blueprints or merely tell us what you need and we'll design from scratch. You'll find our quotations fast, realistic and offering you good value for the money. The American Pulley Company, 4242 Wissahickon Ave., Philadelphia 29, Pa.



Pressed-Metal Specialties by

AMERICAN

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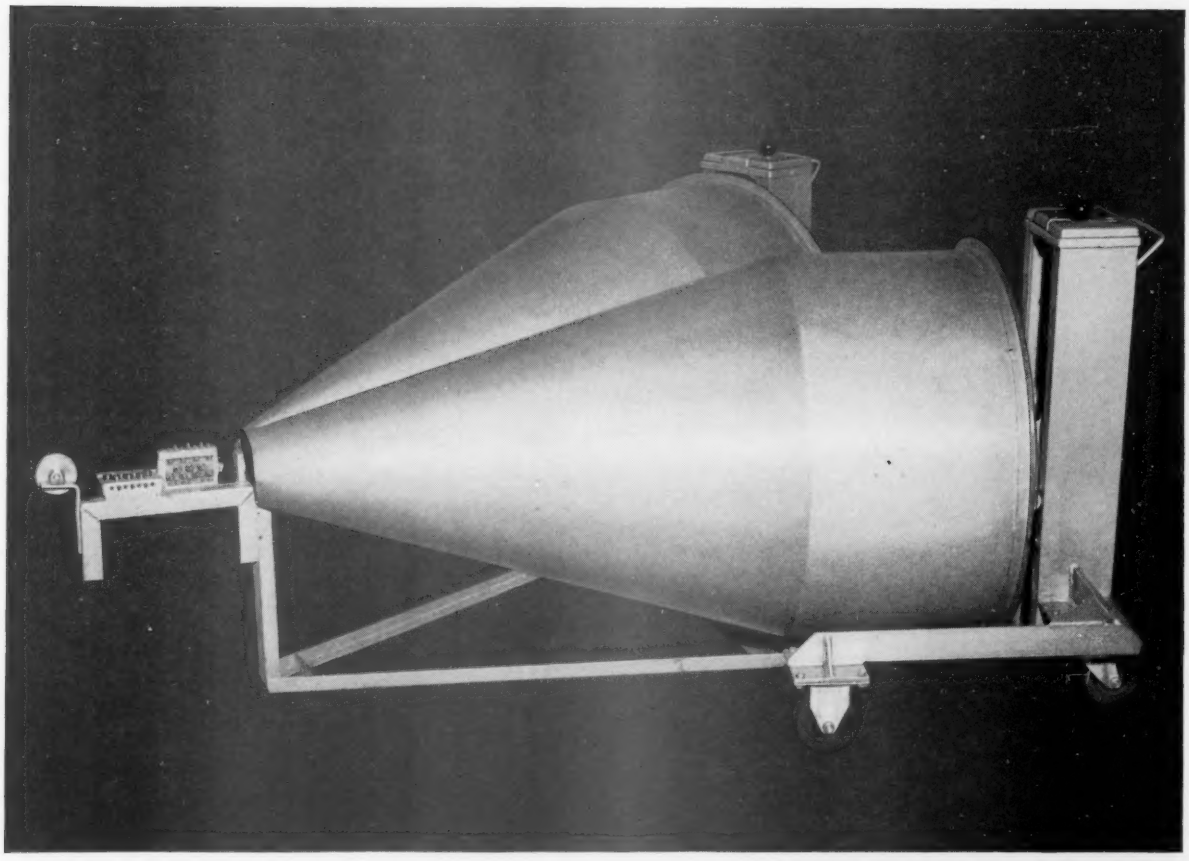
ANNOUNCING THE *ENTWISTLE* CONTINUOUS DUAL FLYER PAY-OFF



Step Up Your Extruder Line Capacity, Simplify Reel Handling Problems With This New High Speed Unit.

Your extruder line operation will reach a new high in speed and efficiency with the new Entwistle Dual Flyer Pay-Off. This new unit enables continuous pay-off of wire in speeds in excess of 3500 FPM, reel weights up to 1500 lbs., and wire sizes down to No. 26 A.W.G.

Switch-over to the second reel is accomplished automatically through a polished steel opening in between the hoods. Braking of reels and all inertia problems are non-existent with this type of pay-off. Dual hydraulic reel trucks make loading and unloading of reels a much simpler operation.

Find out what the new Entwistle Dual Flyer Pay-Off can do for your extruding operations. Write or phone for complete details.

ENTWISTLE
Manufacturing Corporation
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SPECIALISTS IN PRECISION MACHINE BUILDING

• FINE WIRE HIGH-SPEED WIRE STRANDERS, • LIGHT, MEDIUM AND HEAVY RE-SPOOLERS, • TAKE-UPS, • PAY-OFFS, • TINNING TAKE-UPS, • MULTIPLE HEAD RESPOOLING, • CATER-PILLAR CAPSTANS, • TRAVERSE MECHANISIMS, • EXTRUSION MANDRELS, • ENGINEERS-CONSULTANTS

For further information write to . . .

BARTELL MACHINE-TOOL CORPORATION

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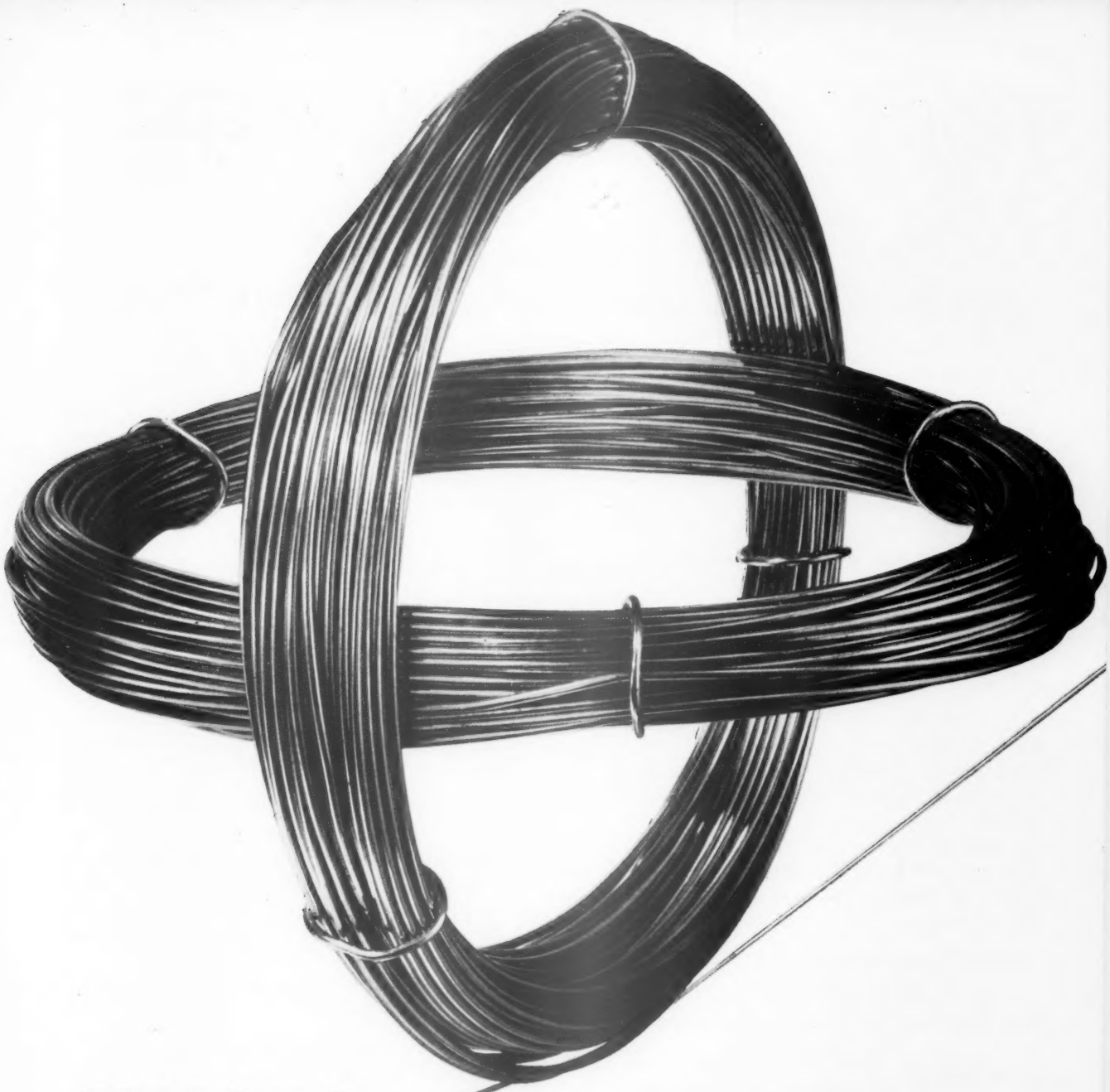

Perfect Balance— is the answer to better wire annealing

Heat balance—that's the answer whether you are annealing ferrous or non-ferrous wire. Lee Wilson's exclusive high convection furnace design eliminates hot and cold spots — assures balanced temperatures throughout the entire furnace. This means that every coil of wire or rod in the charge, whether it's at the top, middle or bottom of the spiders, gets the same amount of heat applied to the coil surfaces. Every coil comes from the furnace with exactly the same annealing treatment. This is one of the big reasons wl more wire and rod are annealed in Wilson furnaces tha in all others combined!

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MAKE THE BEST METALS BETTER

® ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNA

PACIFIC COAST REGIONAL MEETING

THE WIRE ASSOCIATION

TWO DAYS

JUNE 13 & 14, 1957, FAIRMONT HOTEL, SAN FRANCISCO, CALIF.

The Program

Thursday, June 13th

10:00 A.M. to 2:00 P.M. — REGISTRATION — in the Fairmont Hotel Lobby.

2:00 P.M. to 5:00 P.M. — PANEL DISCUSSIONS in the San Francisco Room.

SUBJECT: HANDLING, PACKAGING AND SHIPPING OF WIRE PRODUCTS.

MODERATOR: Lloyd Albright, Colorado Fuel and Iron Corp., Pacific Coast Div., Oakland.

PANEL SPEAKERS:

Edwin H. Migge, Colorado Fuel and Iron Corp., South San Francisco—"New Developments in Mill Packaging."

H. L. Rothwell, E. H. Edwards Co., South San Francisco—"Handling and Storage of Wire Products."

R. T. Merrell, Columbia-Geneva Steel Div., U. S. Steel Corp., Pittsburg—"Mill Finishes."

SUBJECT: NEW DEVELOPMENTS IN WIRE MACHINERY.

MODERATOR: A. B. Krieder, Bethlehem Pacific Coast Steel Corp.

PANEL SPEAKERS:

Eugene Daugherty, Vaughn Machinery Co., Cuyahoga Falls, Ohio—"Wire Drawing Machinery"

J. M. Miskovich, Lee Wilson Engineering Co., Cleveland, Ohio—"Heat Treating Equipment."

F. B. Stone, Stryco Manufacturing Co., San Francisco —"Welding Machinery."

F. J. Rybak, The Lewis Machine Co., Cleveland, Ohio —"Wire Forming Machinery."

Friday, June 14th

8:00 A.M. to 10:00 A.M. — REGISTRATION — in the Fairmont Hotel Lobby.

10:00 A.M.—Busses leave main entrance of the Fairmont Hotel for Pittsburg, Calif. for TOUR OF WIRE MILL OF PITTSBURG WORKS OF COLUMBIA-GENEVA STEEL DIV., U. S. STEEL CORP.

11:30 A.M. to 4:00 P.M.—PLANT TOUR—LUNCH—as guests of Columbia-Geneva.

4:30 P.M.—Busses leave plant for return to Fairmont Hotel.

6:30-7:30 P.M. — COCKTAILS — TERRACE ROOM, courtesy of Bethlehem Pacific Steel Corp., San Francisco; Colorado Fuel & Iron Corp., San Francisco; E. H. Edwards Co., South San Francisco and John A. Roebling's Sons Corp., San Francisco; Planett Manufacturing Co., Oakland; Wire Specialties Corp., Santa Clara.

Music will be furnished through the courtesy of R. H. Miller Co., Homer, N. Y.

7:30 P.M.—DINNER—TERRACE ROOM
SPEAKER: George W. Bunton, Astronomer, California Academy of Sciences, San Francisco—"Why Space Travel."

9:00 P.M.—FILM: "The Long Pull"—Color movie showing manufacture of wire and its applications. Shown through the courtesy of Bethlehem Pacific Coast Steel Corp.

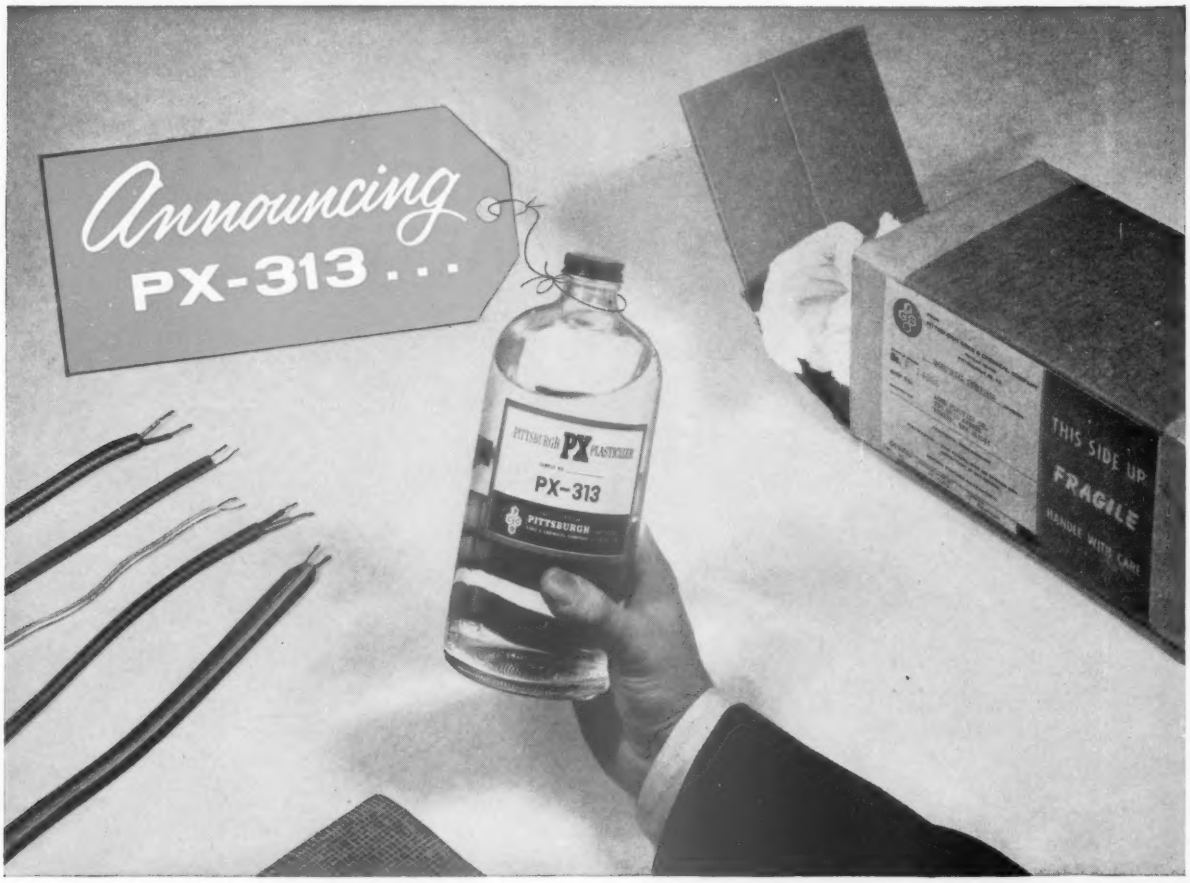
DOOR PRIZES WILL BE GIVEN

The Program Committee cordially invites all wire men — East and West — to come to San Francisco for the Regional Meeting.

THE WIRE ASSOCIATION

Richard E. Brown, *Executive Secretary*

453 MAIN STREET **STAMFORD, CONN.**



. . . Pittsburgh's New Primary Plasticizer!

HERE is a completely new Pittsburgh Plasticizer that may enable you to realize important cost reductions if your production requires a primary plasticizer with excellent low temperature flexibility, low volatility and good processing characteristics.

A modified alkyl phthalate, PX-313 imparts a low temperature flexibility in vinyls equivalent to that obtained with normal octyl-normal decyl phthalates, but at appreciably lower plasticizer cost.

PX-313 is thus ideal for high quality coated fabrics, sheeting and film. Its low volatility and excellent heat stability make it equally suitable for vinyl-jacket wire and other extruded products where elevated processing temperatures are encountered. And because of the good initial viscosity characteristics and excellent shelf life PX-313 provides, it is considered excellent for use in plastisols.

If the economics of this newly developed Pittsburgh Plasticizer seem to offer potential advantages in your operations, *we invite you to send for a sample and data file today.*

Send for your Free Data File and Sample!

PX-313 Data File contains comprehensive reports on specifications, physical properties and performance characteristics. Sample and data file sent without obligation.

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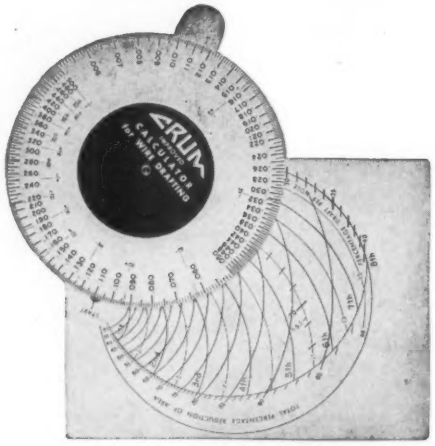
COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

SAVE SET-UP TIME WITH THE . . .

CRUM CALCULATOR

FOR WIRE DRAFTING

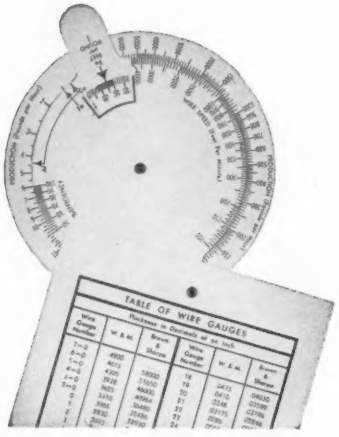
Useful and Accurate!



Front view of Crum Calculator.

THIS NEW DOUBLE-PURPOSE CALCULATOR WILL:

1. Provide quicker and more accurate information on die sizes and reduction areas;
2. Calculate wire production rates for various speeds and efficiencies.



Reverse view of Crum Calculator.

SOME OTHER FEATURES OF THE CALCULATOR

- Has new scale for more accurate determination of small percentages.
- Gives readings in B & S gauges.
- Intermediate lines provide reductions for 16 holes in one setting.
- New rectangular shaped back for better protection of calculator.
- More legible % draft-per-hole scale.
- Vinyl plastic construction, resistant to wear, warping, dirt, perspiration, wire drawing soaps—can be cleaned.
- Still fits your vest pocket.
- Handy tables of W & M and B & S gauges.
- Feet per pound calculating scale for steel, copper and aluminum wires.
- Durable, accurate, easy to use.

The improved Crum Calculator is worth its weight in gold in time saving —no laborious mathematical calculations necessary when you use it. Instruction sheet with examples accompany each Calculator. You should have one or more in your wire drawing department.

THE PRICE: $5.00 EACH

Send your orders to:

WIRE AND WIRE PRODUCTS

453 MAIN STREET **STAMFORD, CONN.**

(Exclusive distributors)

THE BEELINE WIRE DRAWING MACHINE

Straight-line type Wire Drawing Machine for high production of all wire grades

This picture shows a Beeline DG 4, built for an inlet wire diameter of about 7 mm (.28 inch). High carbon steel.

Prominent Beeline features:

- Complete absence of slipping between wire and block.
- Direct block-to-block wire running, with automatic speed control and no loops or other mechanical adjusting devices.
- Continuous speed adjustment from almost zero up to maximum.

Let us help you solve your problems. We shall be glad to answer your questions promptly. Don't forget to let us know what wire is to be drawn, the inlet and finished diameter, its intended use, the production required, and all other relevant information (tensile strength of the finished wire etc.). Then we can suggest a machine that is just right for you.

The machine is at present manufactured in three different sizes:

BEELINE DG 5

for heavy wire, about 13 mm. (.500 inch)

BEELINE DG 4

for wire rods, about 7 mm. (.28 inch)

BEELINE DM 3

for wire with an inlet diawire of about 3 mm. (.116 inch)

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Cables: Morgårdshammar, Ludvika. Tele: 0240–71100

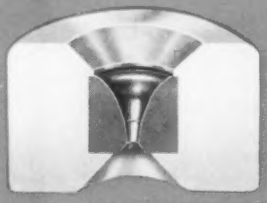
For Drawing Wire, rod, bar and tube . . .

V-R DIES

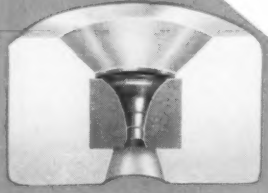
Rough Cored—Standard Hole and Nib Sizes

WIRE DIES
Rough cored sizes from
.004 to .028

BAR AND TUBE DIES
Rough cored sizes from
.275 to 2.725



WIRE AND ROD DIES
Rough cored sizes from
.015 to .200

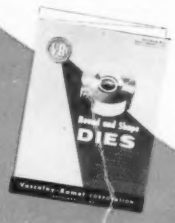


ROD AND TUBE DIES
Rough cored sizes from
.230 to .725

Time and money saving V-R rough cored dies employ an exclusive grade of carbide specially developed and manufactured by V-R to deliver maximum life. An improved method of die assembly plus a cylindrical nib insure a high degree of concentricity, and maximum strength.

You can count on V-R die quality and design . . . V-R originated preformed back relief for drawing dies. Costly die room roughing operations were eliminated over the entire range of hole sizes, saving wire mills time and money. Die men found it easier too, to produce high quality finished dies. V-R has also been foremost in producing rough cored dies in the smaller hole sizes .004 and .010.

Write today for Die Catalog VR-461. It contains complete data on the V-R round dies illustrated and also lists rough cored square and hexagon shaped dies and custom-cored rectangular dies.



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D-613

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MANUFACTURERS OF CEMENTED CARBIDES • TANTUNG CAST ALLOYS • CUTTING TOOLS • DIES

The Wire Outlook

There are probably many steps that our elected representatives in Washington could take that would go far toward the preservation of our ideals of freedom.

Among these would be the enactment of restrictive labor laws limiting the monopolistic actions of labor organizations. This should be done before the too-powerful unions take over the country with their un-American ideas. No union should be immune to the legal liabilities and limitations to which individuals and businesses are subject.

We do not believe that the rank and file of their members, many of whom are not union men of their own volition, are in accord with what goes on in high places—they just have no voice in the un-democratic procedures that are so widespread. Broadly speaking, racketeers, with their squads of goons, are running union affairs on the basis of self-interest.

Another desirable action would be the trimming of the budget to the hard core of necessities. There are some Federal services that we'd be better off without. We should have fewer and smaller bureaus. Many of them have representatives all over the globe, spending our money rashly and without regard to common sense. For a prime example of what goes on, read "How Not to Handle Foreign Aid" in the Readers' Digest for February, page 25. A lot of the larger Federal bureaus are said to engage in lobbying and, through these efforts, to become a little bigger each year. Some few cuts in their requests for funds have been made this year, but not nearly enough.

A third essential step, that can only follow budget paring, would be tax reductions for both individuals and corporations. It is ridiculous to contemplate that twelve years after the close of the last world war, we find ourselves still burdened with special war-time impositions. True, a cold war and the threat of a shooting war are ever with us, but preparedness measures could be carried on while reducing the debt and eliminating confiscatory taxes, if waste, raids on the treasury by special interests and unneeded bureaucratic services were curtailed or cut out completely.

Write your senators and representatives in Congress now, setting forth your views. Public opinion is powerful, if expressed.

Current views of economic observers are that business will continue to be good, even if not booming, but it is going to be harder to make a profit. Economy in manufacturing will be stressed and already it is becoming harder to find jobs. Unemployment will not be serious, but slightly on the increase. Men out of work can thank their labor leaders for their lot. Broadly, this year will be one of quiet correction. A higher degree of stability will characterize business in 1957. As the year progresses, money should become easier, which will spur buying somewhat.

Inventory adjustments are still going on. In the steel field buying is slack, but as inventories disappear, steel products, including wire, are likely to become more active. Steel output fell to 92% of capacity at the end of the first quarter.

Copper prices tended downward in the first quarter, with a slight reversal of the trend toward the end. Tin prices took a sharp spurt—up £90 to £730 per ton, which, it is felt, may have some bearing on its future use.

Brass mills report that business is slow, although some pick-up was reported for April. Some of the poor sales are attributed to foreign imports.

Better carbon steel wire business is expected. The merchant wire demand, while not spectacular, is better than last year. Nail production in the East is off, because of foreign goods coming in at lower prices, but in the Midwest the nail business is fairly good. Most wire men look for a general improvement in sales of most types of wire and wire products before the year progresses much further.

Evidently the year will not be an exciting one; if it carries along with even moderate betterment, we can be grateful that long years of government and labor excesses have not brought about a serious corrective reaction before this.

Edmund Duval Sickels
EDITOR

STEELSKIN Lubricants

—and how to use them...

This is another in a series of advertisements cataloging the complete line of Steelskin Lubricants. Keep this for handy reference.

(No. 5 of a series)

PRODUCT	DESCRIPTION	SHIPPING INFORMATION	USES
#76	Metallic Soap Powder	Fiber Drums 275# Net	For drawing rod or wire coated with lime or STEELSKIN W-Coating Compound. End uses include wire for springs, nails, rope, galvanizing, tire bead, poultry netting, screen cloth, etc.
Redskin	Blended Crystals	Fiber Drums 400# Net	For the economical production of an adherent and uniform copper-coating on both high- and low-carbon wire without the use of an electric current.
X-2	Compounded Soda-Soap Powder	Fiber Drums 275# Net	A general-purpose dry powder for high- and low-carbon rod and wire. More readily cleaned after drawing and annealing. For welding wire and coat-hanger wire (on continuous machines) using a light lime.
560-M	Paste Compound	Steel Drums 480# Net	A water-emulsifiable compound resistant to lime, used to produce a bright finish on bar stock prior to straightening and cutting.
X-Bright Grease	Paste Compound	Steel Drums 480# Net	A one-hole lubricant for producing extra-clean extra-bright wire.
Z-Bright Grease	Paste Compound	Steel Drums 480# Net	A multiple hole lubricant for producing bright grease-drawn wire.
#120	Compounded Soap Powder	Fiber Drums 300# Net	For the production of stainless steel wire without lead and other difficult high and low carbon drawing.
PF Bars	Waxy Solid	Fiber Drums	For use on the take-up frames of patenting units to prevent binding and facilitate bundle removal.

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WIRE AND WIRE PRODUCTS

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 32 - May, 1957 No. 5

Mechanics of the Slipping Capstan

by J. F. Stoltz, Department Chief
Rod and Wire Development Engineering
Western Electric Company, Inc.
Chicago, Illinois

In this article the author describes the mechanical phenomena of the Slipping Capstan, phenomena not always understood and therefore often ignored in the drawing of non-ferrous wire.

With the exception of the wire rawing die itself, one of the most idely used mechanical elements the non-ferrous wire industry day is the slipping capstan—a pstan having a peripheral speed at is different from that of the re which is wrapped around it. espite the widespread application ich it finds, however, the meanical phenomena which this de- e involves are not always fully derstood by the wire engineer l, unfortunately, are sometimes npletely ignored. A brief review some of the fundamental prinles, therefore, appears to be in er.

* * *

The most common application the slipping capstan is found the wire drawing machine or ilar equipment where the cap- speed is greater than that of ne wire which it carries and urges forward through the machine. Fre- ly, we have heard its action ibed as a cyclic kind of system ein a bit of tension in the delivered wire causes the wire to tighten and snub itself on the capstan which in turn delivers more wire to relieve the tension, thus permitting it to slip again. Under this somewhat hazy concept, the cycle is apparently repeated many times at some unknown frequency so that the appearance of a continuous flow of wire is given.

* * *

Actually, the action of the slipping capstan is continuous and it might be much more accurate to view it as a continuous, self constituted and controlled clutch in which the degree of engagement is in direct proportion to the tension in the wire. In order to evaluate the frictional forces involved, let us take a moment to analyze the device from a mathematical standpoint.

* * *

If a wire is placed under a tension, t, and caused to contact the stationary capstan in Figure 1 over a very small angle of contact which we shall designate as da, the total radial pressure at the arc of contact may be expressed as 2 t Sin 1/2 da. If da is very small, then Sin da = da (expressed in radians) and the radial pressure is t da.

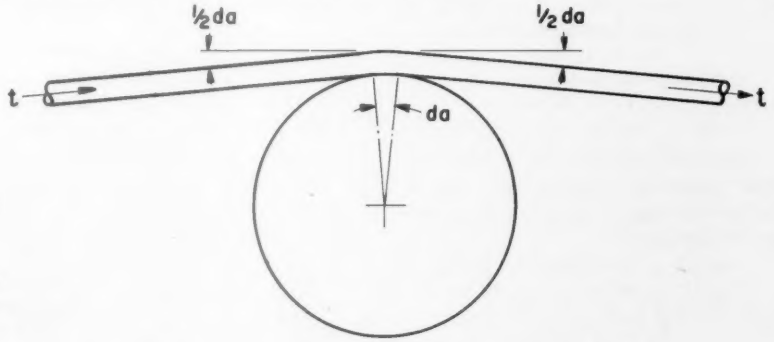

Figure 1.

If we now wrap the wire over the capstan so that the angle of contact is much greater, as illustrated in Figure 2, the new angle of contact, A, is made up of the sum of many small angles such as da and the radial pressure at each increment of wire contacting the capstan is t da where t represents the tension in the particular increment under consideration.

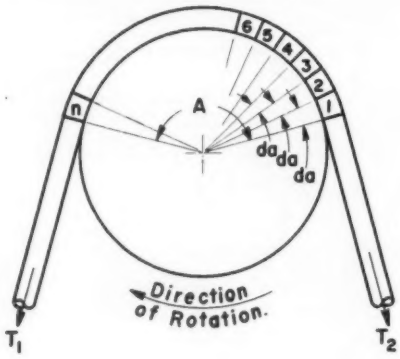

Figure 2.

Let us now consider what happens when the capstan in Figure 2 is rotated and exerts a frictional force on the stationary wire. If an initial tension, which for convenience we shall designate as T_2, is placed on the wire, the tension in the first increment (1) contacting the capstan is the initial tension T_2 plus the frictional force on this increment caused by the capstan which is urging it in the same direction as the initial tension. The frictional force on this increment is independent of speed (sliding friction always is) and is equal to its radial pressure, T_2 da, times the coefficient of friction, u. The total tension at this increment, therefore is

Tension at first increment = $T_2 + T_2$ da u

or, Tension at first increment = T_2 (1 + da u)

★ ★ ★

This value is also the initial tension applying against the second increment (2) and its tension may be written

Tension at second increment = T_2 (1 + da u) (1 + da u)

or, Tension at second increment = T_2 (1 + da u)^2

★ ★ ★

Thus, from one increment to the next, tension builds up very much like a sum of money invested at compound interest. The final tension T_1, which is the tension at the end of n increments is

$$T_1 = T_2 (1 + da\ u)^n$$

★ ★ ★

For mathematical convenience in solving for T_1, we shall now introduce a new quantity, X, by the relation

$$X = \frac{1}{da\ u}$$

so that the expression for T_1 may be written

$$T_1 = T_2 \left[\left(1 + \frac{1}{X}\right)^X\right]^{n\ da\ u}$$

★ ★ ★

As da becomes infinitesimal, the value of X becomes infinitely great and the student of calculus will recognize that the quantity in the brackets approaches the base e of the natural logarithms. Thus, our expression for T_1 may be written

$$T_1 = T_2\, e^{n\ da\ u}$$

and since the value n da is equal to the total angular contact, A, it may be finally simplified to

$$\frac{T_1}{T_2} = e^{uA}$$

★ ★ ★

It is interesting to note that this is very similar to the expression for the increase in principal of a fund invested where interest is compounded at every instant.

★ ★ ★

If angular contact is expressed in the number of wraps, N, rather than radians, and e is expressed in terms of its numerical value, the equation is ready for practical use by the engineer and designer:

* $\frac{T_1}{T_2} = 2.718^{2\ Nu}$ or $\frac{T_1}{T_2} = 2.718^{6.283\ Nu}$

★ ★ ★

This relationship is equally as basic and important to the nonferrous wire engineer as Ohm's Law is to the electrical engineer. The most fortunate part of it is that the ratio of the two tensions, T_1 and T_2, is **entirely independent** of speed and diameter of the capstan, being a function only of the coefficient of friction and angular contact. Movement of the wire in either direction over the rotating capstan in Figure 2 merely changes the relative speed between wire and capstan and, therefore, does not alter our mathematical treatment so long as some degree of slip is maintained in the same relative direction. If the direction of slip is reversed as it might be if a wire, moving in the same direction, but slower than the capstan, were accelerated until its speed exceeded that of the capstan, then the same ratio will apply, but in the inverse order. That is, T_1 will become T_2 and T_2 will become T_1.

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Thus, when the number of wraps on the capstan remains unchanged and when the friction coefficient remains unchanged, the tension ratio will be constant and independent of the speed of the wire and the capstan so long as slip is maintained in the same relative direction. A slipping capstan, therefore, may be regarded as a mechanical amplifier operating either to amplify or divide changes in tension, depending upon the direction of slip.

★ ★ ★

Figure 3 illustrates the basic components of a very simple wire drawing machine. If the capstan is rotated at any speed and we do not pull on the wire, the capstan will slip and the wire will be at zero tension (theoretically) throughout the system. Actually, the weight of the wire will cause some tension, T_2, and this will be multiplied to a higher value, T_1, at the wire die. The multiplier, of course, is $(2.718)^{6.283Nu}$. If we pull slightly to increase the tension T_2, the tension T_1 is increased in direct proportion and the same multiplier still applies. T_1, therefore, reaches the die pull when we pull T_2 to the value:

$$T_2 = \frac{\text{Die Pull}}{(2.718)^{6.283\ Nu}}$$

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At this point, the wire begins to move. T_1 is now limited by the die pull and it is a well known fact that this is independent of speed for a given reduction and drawing die. Since the tension ratio is constant, T_2 is also constant and

* Erratum: In power, between "2" and "Nu," insert "π."

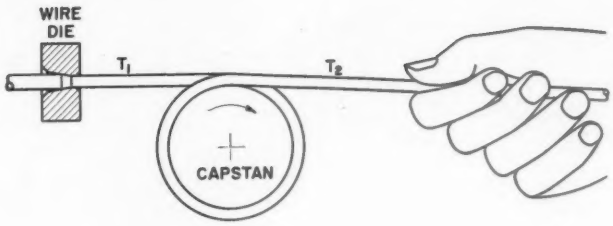

Figure 3.

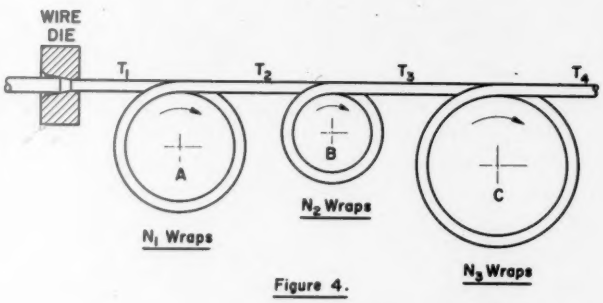

Figure 4.

limited to the value given above. If we pull more on the wire, T_2 does not increase—the wire merely comes faster—until the speed of the wire reaches that of the capstan. When this occurs, the capstan is no longer slipping and our formula does not apply. Under no-slip conditions, T_1 and T_2 have no definite relationship and T_2 is indeterminant. This means we can pull T_2 up to any desired tension greater than the above value provided we maintain the speed of the wire equal to that of the capstan (to prevent slip) and further provided that we do not exceed the slip tension ratio in the reverse order in which case the wire would reverse the previous direction of slip and its speed would exceed that of the capstan. Under these conditions, the new value for T_2 (T_2') would be

$$T_2' = \text{Die Pull} \times 2.718^{6.283\,Nu}$$

★ ★ ★

Under normal application, this condition would never be reached since with customary die reductions and capstan wraps, the tension T_2, would exceed the breaking strength of the wire many times. In some applications, however, this condition can exist and when it does, the tension T_2, becomes constant when the forward slip occurs and remains so regardless of how much faster the wire may be pulled.

★ ★ ★

When more than one capstan is used without intervening restraining forces such as wire drawing dies, the sum of the angular contacts on each may be used to compute the final tension. Such a system is illustrated in Figure 4.

★ ★ ★

The final tension T_4 could be computed by determining T_2, T_3, and finally T_4, but this would be laborious. Consider, for example, the case where all three capstans have peripheral speeds faster than the wire and a common coefficient of friction:

$$T_1 = \text{Die Pull}$$

$$T_2 = \frac{\text{Die Pull}}{2.718^{6.283N_1u}}$$

$$T_3 = \frac{T_2}{2.718^{6.283N_2u}} = \frac{\text{Die Pull}}{(2.718^{6.283N_1u})(2.718^{6.283N_2u})}$$

$$T_4 = \frac{T_3}{2.718^{6.283N_3u}}$$

$$= \frac{\text{Die Pull}}{(2.718^{6.283N_1u})(2.718^{6.283N_2u})(2.718^{6.283N_3u})}$$

$$\text{or } T_4 = \frac{\text{Die Pull}}{2.718^{6.283u(N_1+N_2+N_3)}}$$

★ ★ ★

The exponent of e in the denominator now clearly contains the sum of the wraps in the entire system which may be treated as though it were one capstan having all of these wraps.

★ ★ ★

Similarly, if slip is not in the same direction throughout a multi-capstan system, the net difference in total wraps may be used. For example, if capstan B in Figure 4 is slipping in the reverse direction due to its smaller diameter, the final tension is

$$T_4 = \frac{\text{Die Pull}}{2.718^{6.283u(N_1-N_2+N_3)}}$$

★ ★ ★

The question might be raised as to what happens when external forces prevail on the wire in such a way that the computed slip tension ratio cannot be reached. An illustration of this would be when we pull on the wire in Figure 3 so vigorously that we bring the tension T_2 up to or near the die pull tension T_1. When this occurs, we may be definitely assured that the wire will not slip on the capstan and the formula, therefore, does not apply. In a system containing a large number of overdriving capstans **without restraining** forces between them, the total number of wraps may be such that the weight of the wire alone is sufficient to increase the final tension beyond the computed value for slip so that the system is obliged to operate under no-slip conditions. If the wire is not taken away from such a system as fast as the capstans deliver it, it will "run ahead" and will usually result in a miserable tangle.

★ ★ ★

One important consideration in dealing with slip in the wire drawing machine is the power loss which is occasioned by friction losses on the capstan. To derive a formula for this, we could refer back to Figure 2 and integrate the losses occurring at each increment of the wire, but this is hardly necessary in this case as it seems fairly obvious that the total force on the wire contributed by friction is the difference in tensions (T_1-T_2) and that this force times the slip speed (difference between capstan peripheral speed and wire speed) represents the total power loss at the capstan. In terms of foot-pounds per minute, this may be expressed:

Power loss = (C-W) (T_1 − T_2)
where C = Capstan peripheral speed (ft. per min.)
W = Wire speed (ft. per min.)

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The power input to the capstan shaft is a function of the torque and rotational speed, but this, too, may be expressed in terms of capstan peripheral speed and the difference in tensions:

Power input = C (T_1 − T_2)

★ ★ ★

It is usually most convenient to

(*Please turn to page* 569)

Wire Coating Quality Aided by Automatic Viscosity Control

by Edmund D. Sickels, Editor
Wire and Wire Products
Stamford, Connecticut

Every mechanical development that removes from a production operation the need for judgment on the part of man, with all its attendant liability to error, contributes to uniformity in products. It is with this in mind that this article, describing just such a device, is presented to our readers.

Manual determination of the viscosity of a material being applied to wire by a continuous dip process for insulating purposes, although operators and technicians may strive conscientiously for perfection, is almost certain to be unreliable at best.

★ ★ ★

In the very nature of things, solvents will evaporate and the viscosity values of insulants correspondingly will become altered. This necessitates frequent checks and corrections. When done manually in the conventional manner, check intervals may vary, readings may involve the human factor of liability to error and amounts added may be incorrect, resulting in a condition that is more often than not likely to be at considerable variance with any pre-determined value that it is desirable to maintain.

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Up to recently it has been customary to use a pipette or a cup, timing the flow of the enamel manually to determine its viscosity, when a device called the "Viscometer" was perfected not only to check the viscosity automatically, but to make the solvent additions at regular frequent intervals to replace amounts lost through evaporation.

★ ★ ★

Such automatic viscosity control, it might be mentioned, is applicable, not alone to wire coating systems, but to any type of product finishing in which evaporable solvents are utilized.

Wire Mill Experience

In southern Vermont a progressive and rapidly expanding electric wire plant has been making effective use of this testing and control instrument.

★ ★ ★

The concern's business is that of making specialized types of wires for which exceptional quality of work and the meeting of rigid specifications are routine. For example, much of their work is done for aircraft applications, in which failures cannot be tolerated.

★ ★ ★

The company has installed viscometers to give them continuous measurement and control of the viscosity of the fluid without attention on the part of the attendant. The equipment operates automatically and is provided with a signalling arrangement—light, bell or buzzer, as wanted—set to function just above and below the maximum and minimum predetermined viscosity values. This issues a warning in the event of faults developing in temperature controls, solvent or enamel supply exhaustion and other factors that might affect the degree of viscosity that should be maintained.

★ ★ ★

Experience has shown that with the installation of automatic viscosity control equipment it is possible to consistently secure uniform coatings of desired thicknesses, since the continual evaporation of the volatile solvent is automatically compensated for by small frequent additions of solvent to the coating solution.

How the Equipment Works

In a wire coating set-up there are four tanks, one holding the enamel, another containing the solvent, a third filled with a mixture of the two to be applied to the wire, and the last an elevated tank for gravity feed of the enameling solution to the dip pans

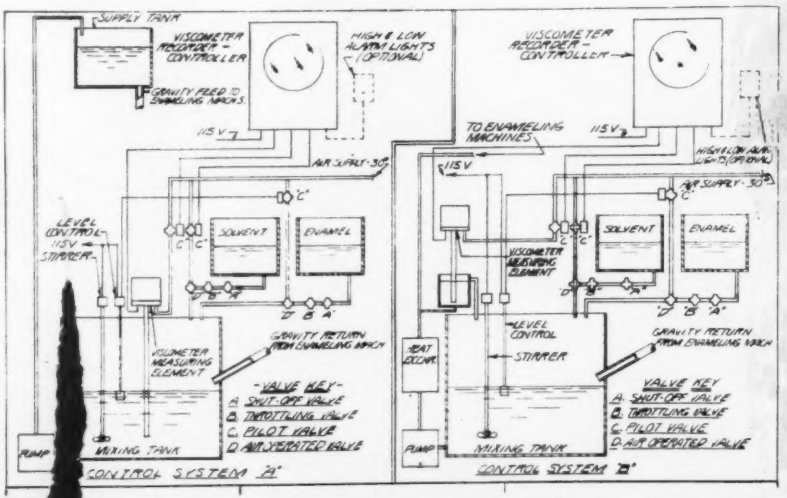

Fig. 1— cosity Control System for Wire Enameling—Coating. System A is the one referred to in t rticle.

NEWS OF INTEREST TO THE WIRE AND CABLE INDUSTRY VOL. II No. 2

WIRE Recorder

PUBLISHED BY MONSANTO CHEMICAL CO., PLASTICS DIVISION, SPRINGFIELD, MASS.

MONSANTO

Trend to Street Lighting For Miles of Dark Super Highways

Fifty-three miles of continuous illumination on Connecticut's new turnpike may mark the beginning of a new approach to highway safety. While modern highways in heavily populated centers generally are lighted, the Connecticut project represents the "first and largest continuous stretch of expressway lighting on the open road."

The objectives of the $2,600,000 lighting program, which provides continuous powerful mercury vapor luminaries staggered 100 feet apart along the stretch, are: to reduce nighttime accidents by providing brightness contrast to permit better obstacle recognition; to contribute to driver comfort and, thus, tend to lessen the early evening peak loads by stimulating nighttime driving; to increase roadway capacity and bring it up to the daytime pattern, for it is well recognized that at night all drivers hesitate to use all of the roadway.

Year-long before and after tests were conducted on a heavily traveled segment of the Berlin Turnpike near Hartford prior to approving the continuous light belt installation. Tests showed that continuous lighting reduced night accidents and injuries by 29%, while the fatality rate was cut 100% — to zero from 8.65 for each one hundred million vehicle miles.

This new approach to highway safety may also mark the opening of a great new market for insulated wire as other experimental stretches are being considered elsewhere. Entrance and warning light systems are to be expanded and continuous lighting of most state and federal freeways and turnpikes is believed to be inevitable. Continuous highway illumination will probably become an intrinsic part of the nation's multimillion dollar new highway improvement program.

Portion of Berlin Turnpike (Conn.) test strip showing the effect of continuous illumination.

Now "Ultrasonics" Busts Through Sales Barrier

If manufacturers of insulated wire believed that "electronics" was the newest field which would affect future applications of wire and wire products, here is something brand new.

Ultrasonic equipment, a relative newcomer, is rapidly gaining in popularity among industrial and medical users. Manufacturers estimate 1956 sales between $15 and $25 million and look for a 25% sales increase this year.

Dramatic labor and material savings account for the rapid acceptance of this equipment in many industries which, until a short while ago, had never heard of ultrasonics. The most popular applications today are for cleaning, testing, tinning, soldering, drilling, grinding, and numerous medical uses.

Many industrial uses depend on the force created by cavitation or tearing apart of a liquid vibrated ultrasonically. This produces a scrubbing action which is put to work cleaning and degreasing odd shapes and confined spaces, drilling or grinding with abrasive slurries. In fluxless soldering or tinning, the molten metal acts as the cavitation liquid. The drilling-grinding technique allows cutting unusual shapes and holes in brittle materials and metals. The electronics industry itself uses ultrasonic cleaners for transmissions and many subminiature parts and assemblies.

MONSANTO WIRE RECORDER
newsletter
MONSANTO

Electronic toys, mostly wired to battery power, are making a big hit with the kids. Despite comparatively high prices, sales of such items as transistor radio kits, radio-controlled buses, cars and bulldozers reached $5 million in '56. While current sales are but a fraction of the total toy market, the romantic appeal electronics has for youngsters is expected to keep sales climbing rapidly. Lower prices, within the mass toy range, will mean a tremendous new market in wire trade.

Alaska submarine telephone cable opened for use. Lost in the big news of the new Atlantic cable, the 1,250-mile Alaska cable represents a new and important communication link between the U. S. and the growing Territory of Alaska. Stretching between Port Angeles, Washington, and Skagway, Alaska, the system which took over three years to build can carry 36 conversations at one time. It will be used to supplement the radio-telegraph and land line facilities that have been operating since 1937.

Despite current sales lag, TV set makers continue optimistic about future sales. First-set saturation is still some time off: 78% of U. S. households have TV, although 97% are within signal range. The second-set market is virtually untouched, with battery-powered transistor portables important in the picture. Replacement sales must also pick up as many sets are now more than four years old. Finally, color sets may outsell black and white by 1962.

Parking meter with electric eye to keep motorists from using unexpired parking time is the latest vexation for the thrifty motorist. San Francisco is currently testing this "miserly meter" which flips its time indicator back to "expired" when an auto leaves the parking spot. It is estimated that the new electronic device, attached to standard parking meters, will boost revenue 50% to 60%. According to the Sales Manager for the maker, some motorists don't like it. He says, "We had a good many of them say that as long as the time is paid for, they are entitled to have it." Parkers can take some small comfort in the fact that the electric eye won't work at night.

Electronic computers at bargain prices - as low as $1,000 - may be the result of current research activities. New materials based on the science of cryogenics, the study of how materials behave at temperatures down near absolute zero, may mean that in 10 years computers now costing $1 million will sell for only $1,000. These large-scale digital computers will occupy only one cubic foot, exclusive of refrigeration and terminal gear. Other factors which make the cryotrons attractive to industry are high reliability, exceptionally low cost, and fewer components needed. So far cryotrons can't compete with transistors or electric tubes in switching speed, but further research and developing is expected to boost their speed a hundredfold. Science again opens up a great new wire market!

NEMA PUSHES REWIRING PROGRAM

Expansion of current activities and the initiation of new programs are expected to bring a strong sales message to millions of residential, commercial and industrial electricity users throughout the nation as the National Electric Manufacturers Association attacks inadequate wiring on all fronts.

The importance of older dwellings in the wiring picture is due to less new home construction. NEMA has therefore planned activities in cooperation with other segments of the industries to sell the theme "Live Better Electrically with Full Housepower" to the millions of owners of homes more than 10 years old.

Other NEMA activities include sponsorship of National Electrical Week; continued work through the Street and Highway Bureau to create a growing interest in improved lighting; strengthening and promoting the well established liaison between manufacturers and other branches of the industries—utilities, wholesalers, contractors, dealers.

Also scheduled for '57 are continued demonstrations to farm and rural residents, and to electrical industry segments serving them, the economic value and social benefits of modern electrical equipment for production, household and commercial use.

This year will also see the initiation of a specific commercial and industrial adequate wiring program aimed at the tremendous market for rewiring which exists in thousands of electrically outdated commercial buildings and industrial plants. The Food Service Industry is a particularly good market potential.

Polyethylene Insulation For Coaxial Cable

Coaxial cable insulation represents an extremely critical test of the insulating properties of electrical grade polyethylene compounds. These cables are used to transmit signals at radio frequencies for such applications as radar systems, communication systems, and community television systems. In order to minimize power losses to the cable during transmission of high frequency signals, the polyethylene compound must possess superior dielectric properties. As an integral part of this requirement, uniformity of electrical properties and freedom from contamination are necessary.

Monsanto Polyethylene 12253 has proven to meet all of the rigid performance requirements of coaxial cable insulation. Extensive use of 12253 by coaxial manufacturers has shown that cables made from this compound exhibit consistent low loss performance. The ease of extrusion of 12253 has also contributed to the excellent properties of these cables, since electrical performance (including resistance to corona) is greatly dependent upon the ability of the polyethylene compound to be cooled without void formation and within close dimensional tolerances. It has been possible in some operations to increase extrusion rates over those normally used and still produce a cable which readily meets test requirements.

12253 is recommended for use in all coaxial cable applications. Constructions can be made from 12253 which meet the requirements of military specification MIL-C-17B. This compound conforms to the properties described in MIL-D-3054A, Type N.

For those manufacturers desiring maximum versatility, it should be noted that 12253 is suitable for use as primary insulation in telephone cable, high voltage power cable, signal and control cable, microphone cable, and submarine cable. In addition to the coaxial cable specifications listed above, 12253 also meets the following standards and specifications:

1. ASTM D-1248-52T, Type II, Grade 4
2. REA PE-14
3. IPCEA, Appendix P
4. MIL-C-10581A
5. MIL-C-15479B
6. MIL-W-76A

Heavy Federal Spending In Electronic Field

With record sums earmarked for electronics by the Eisenhower administration for fiscal 1958, beginning July 1, 1957, the Federal Government is unquestionably still the largest end-user of wire and wire products in the nation.

The military budget calls for $3.3 billion worth of electronic projects for fiscal '58 as compared to $3.1 billion for '57. The biggest expenditure, $1.6 billion, is for military aircraft and guided missiles, while another $927 million will be spent for other military electronics such as ground communications, ground radar, fire-control gear for tanks and artillery and ground-to-air communications. While in research and development, the Defense Department will be spending $200 million for electronic projects. Agencies outside the Defense Department will also be spending heavily for electronic equipment. The CAA will spend $69 million to convert its ground installation to the new Vortac distance and direction-finding systems. U. S. Information Agency requests $4 million for acquisition and construction of domestic radio facilities.

Coast Guard seeks authority to spend money from a $5.4 million fund appropriated last year for construction of additional loran navigation stations. Supplemental funds will be sought later this year. Weather Bureau will buy $323,000 worth of weather surveillance radar.

National Bureau of Standards will build a pilot electronic data-processing device to cost at least $100,000.

Federal Civil Defense Administration will buy one million survey meters and about 15 million self-reading dosimeters out of its $75 million emergency equipment procurement fund.

All in all, the projected picture of Federal spending in the electronic field will keep manufacturers of insulated wire busy to fulfill their part of the program.

Opalon 1038 and 1046 Pass Decomposition Test

In recent laboratory tests conducted by Monsanto, Opalon 1038 extruded insulation met the Westinghouse specifications (Welco spec. 8241-12) for decomposition with a wide safety margin—less than 1/6th the allowable decomposition. Similar samples of Opalon 1046 performed even better showing less than 1/10th the allowable decomposition.

With Opalon 1038 having previously met the 90°C U.L. requirements and Opalon 1046 having met the 90°C and 105°C U.L. requirements, the favorable results of these two tests mean that another important application may be added to the impressive list for which these two versatile materials may be used.

Thermoplastic Extrusion Booklet Now Available

Compiled by the Monsanto Technical Service Department, a comprehensive manual covering the fundamentals of thermoplastic extrusion is now available. This manual provides basic information on equipment, processes and theories applying to most extruded thermoplastics. Ask for: Bulletin No. 1029, "FUNDAMENTALS OF THERMOPLASTIC EXTRUSION." To obtain your personal copy, write:

Advg. and Sales Promotion Dept.
Monsanto Chemical Company
Plastics Division
Springfield 2, Mass.

MONSANTO ®

New Phenolic Molding Compound For Wiring Devices

A new phenolic molding compound, Resinox 2200 black, combining excellent dimensional stability with high arc resistance and good impact strength, has been developed by Monsanto for use in heavy duty electric control parts and wiring devices.

The new compound is particularly well suited for the manufacture of circuit breakers, switch housings or parts, and other items requiring superior dimensional stability during severe temperature cyclings as well as improved impact strength and resistance to surface arcing. Other features of the new material include low moisture absorption, improved heat resistance, good moldability, excellent finish and adaptability to automatic molding.

Resinox 2200 black is another achievement in Monsanto's continuing efforts to provide materials for the electrical industry which make possible desired reductions in product size and weight while actually improving performance and efficiency.

RESINOX 2200 BLACK

Pertinent Property Values
(ASTM test method, employing molding piece of standard size)

Shrinkage	0.002 to 0.004 in./in.
Impact Strength	0.40 ft. lb./in.
Arc Resistance	150 sec. minimum average

Utilities Spark Expansion And Sales Programs

It is not surprising that, despite inflation and the tight money situation, utility companies are going full speed ahead with ambitious plant expansion and consumer sales programs. In addition to the industry-wide "Live Better . . . Electrically" consumer program, area promotions under the label of "Housepower" will stress the need for rewiring in home and industry.

Prosperous private power companies feel bound to repeat last year's success. Increased lines, load and generating power continue to reflect service and equipment sales jump.

During 1956 a record 8 million kw in new thermal capacity was installed by utilities throughout the nation. This year industry sources expect the same amount to be added to the nation's generating power.

Their total 1957 expenditures for power, transmission and distribution equipment is expected to top the '56 figure by about 12.5%. For suppliers, this points to another record year for sales and service of distribution equipment, automatic machinery and industrial controls.

Opalon 1028 Gets OK As ACT Cable Bulletin

The wire industry has just received notification from Underwriters' Laboratories that Opalon 1028 has been recognized as a bulletin compound for type ACT cable. Opalon 1028 may be used for this application without further submittal by a manufacturer who has recognition for type ACT cable.

The Opalon 1028 formula may be used in either the ready-mix form (compound granules) or the wire manufacturer may mix it at his own plant. Monsanto Opalon 300, 300-FM, and 330-FM are classified by U.L. as interchangeable basic resins of the polyvinyl chloride type for use in production of Opalon 1028.

MONSANTO CHEMICAL COMPANY
PLASTICS DIVISION—SPRINGFIELD, MASSACHUSETTS

on the enameling machines. A schematic arrangement of this system including the viscosity control components is shown in Figure 1, in which System A. is the one referred to here.

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The viscometer measuring element is installed on the mixing tank with the measuring tube extending down into it. At two-minute intervals a sample of the coating solution is drawn into the measuring tube and tested for viscosity, the condition being registered on a recording chart. At such times, whenever the viscosity exceeds the control point a power-operated valve is automatically opened to allow the flow of solvent into the mixture to restore it to its proper degree of viscosity. A throttling valve in the solvent line regulates this solvent flow. The make-up enamel is fed from its tank to the mixing tank by means of a float arrangement which maintains the level in this tank as the mixture is consumed. This viscosity controlled solution is pumped to the supply tank where it flows by gravity to the dip pans on the enameling machines. An overall accuracy of ±1% normally is obtained from this system.

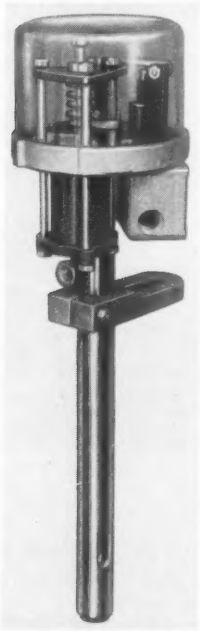

Fig. 2—Viscometer measuring element.

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The viscometer measuring element is shown in Figure 2 and operates as follows:

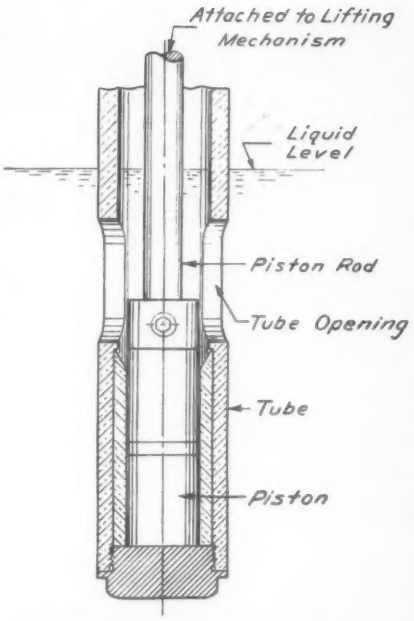

Fig. 3—Cross Section of piston used to draw up sample enamel.

The piston in the lower end of the tube (see Figure 3) is periodically raised by an air lifting mechanism drawing a sample of the liquid to be measured in through the tube openings. The liquid then goes down through the clearance between the piston and the inside of the tube into the space which is formed below the piston as it is raised. The assembly is then allowed to fall by gravity, expelling the sample out through the same path as it entered. The time of fall is a measure of viscosity, with the clearance between the piston and the inside of the tube forming the measuring orifice.

Fig. 4—Viscometer recorder—controller.

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A viscometer recorder-controller is shown in Figures 4 and 5 and this unit contains three adjustable switch points, one used as the control setting and the other two for high and low viscosity alarms. Exceeding or falling below these predetermined limits results in an alarm, the cause of which must then be investigated. For applications not requiring a permanent record, the recorder-controller can be replaced with a non-indicating controller. Since one supply tank usually circulates the coating material to several wire enameling machines, one viscometer may be made to function for anywhere from one to thirty or more enameling machines.

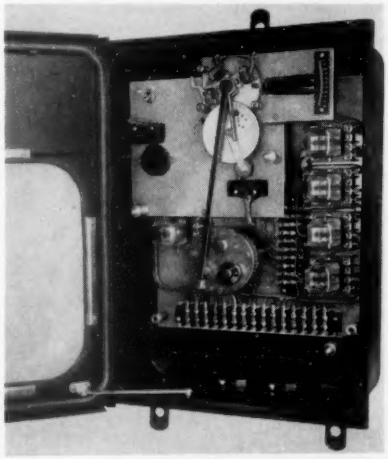

Fig. 5—Viscometer recorder controller with chart plate removed to show mechanism.

Benefits

It has been amply demonstrated in field experience that the use of viscometers has been an aid, not only to the control of quality, but in labor saving as well in those applications requiring frequent viscosity corrections. In addition, increased economy in the consumption of coating material has been observed to be a beneficial result of this automatic control system.

(*Please turn to page* 572)

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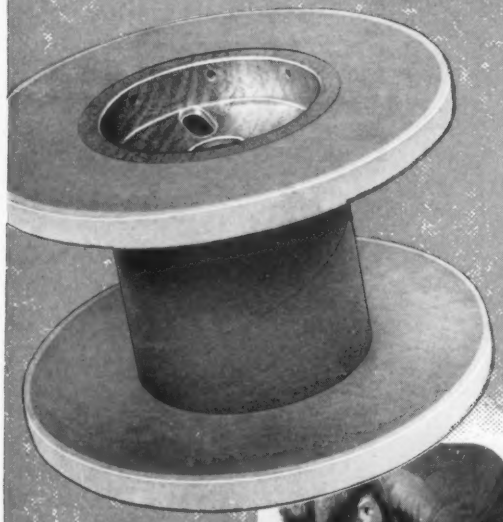

Patent Pending

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We pioneered this disposable reel, announced the process, built pilot models and put them into plants for 8 months of testing.

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4. This insures wire arriving in good condition, and no take-off trouble in the plant.
5. Inexpensive sheet metal pay-off ring insures trouble-free removal of wire. Ring can be used when removing wire over the head or with de-reeling stand employing a rope friction drag.
6. Your name identification and product specifications now in LARGE letters, 2 colors, covering entire head. Five times previous size to improve legibility.
7. Reel fits your present equipment without changes.
8. A truly NON-returnable reel at low cost. LIGHT WEIGHT for big freight savings. Every package bright, clean, new and good looking!

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Reading Instrument Chart Records

by Leo Walter, Consulting Engineer
Eastcombe, England

In this age of instrumentation it becomes important to know how to interpret chart readings. Mr. Walter gives some practical counsel for the guidance of those charged with the responsibility of evaluating the recorded data of equipment operation.

Recording instruments in a great variety are widely used in research and in industry. Either very quick or extremely slow reactions can be recorded, the range extending from the fountain pen record to the modern cathode ray oscillograph which permits of photographic reproduction of split-second events. The great value of recording instruments is that diagrams can be produced when human capacity for reading values becomes inadequate.

* * *

The usual chart records show the measured value as a fraction of time, thus eliminating subjective errors of reading. A chart diagram is a document which not only reproduces single measured values, but offers as irrefutable evidence of happenings a continuous chain of readings unobtainable from indicating instruments.

* * *

It is one thing to install a recording instrument in the plant and to keep it more or less going, and another to take the utmost advantage of the chart it produces. In the following a few hints will be given what to watch when producing chart records on existing instruments in a plant and how to evaluate such records.

Means of Recording

Records are usually made on paper in the form of a circular chart or of a roll or strip chart. Either an instrument pen or a metallic stylus for wax-coated paper is usually fitted to the mechanism. Drum charts are perhaps mostly used for room thermometers, humidigraphs and barographs, or for combination of these instruments. Change of drum charts is required after 12 or 24 hours, or after seven days, according to the instrument.

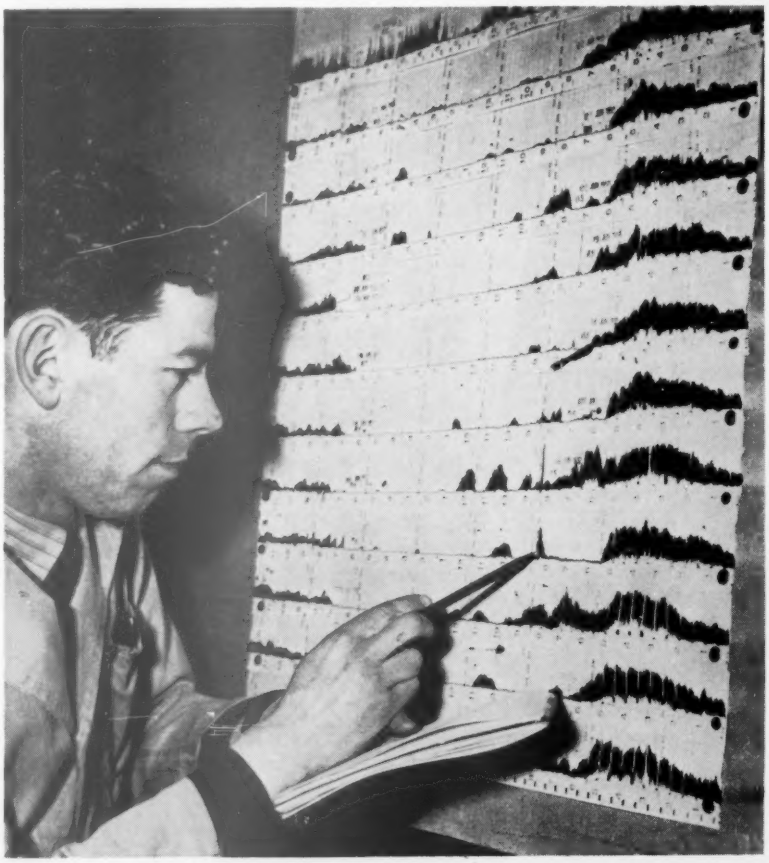
The circular chart is much favoured. It enables quick observation of happenings during time intervals of usually 8, 12 or 24 hours. (See Figure 1)

* * *

Although it is obvious that the value of instrument records depends on correct choice of chart width for drum and roll charts, instruments can be sometimes found working which do not produce the right kind of record. Apart from chart speed, which will be dealt with later, the specific pen movement, i.e., the travel of the pen per unit of change of the measured variable, is of utmost importance in order to detect deviations of a measured value from the desired value. Where greater accuracy of measurement is required, greater chart width or larger chart diameter should be used.

* * *

The question of chart size is also closely connected with indication. Recording instruments using large charts can be observed from a distance and thus offer a useful guide for plant operation. Where the instrument is installed purposely as a help to the plant operator, a combined indicating and recording



Evaluation of several chart records in research.

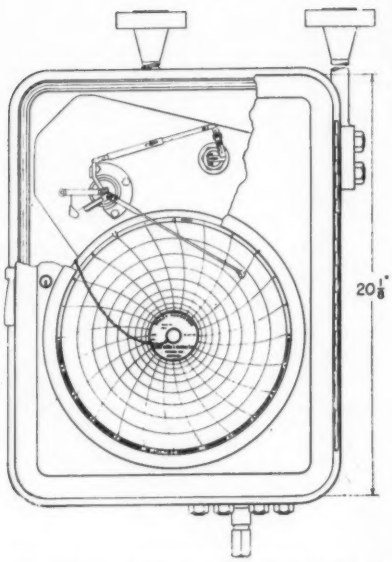


Fig. 1. Bailey bellows operated flow recorder with circular chart. * * * * * * * *

instrument is preferable, and the larger the chart, the larger can be the scale.

Multi-Pen Instruments

It is sometimes advisable to have correlated values recorded on a single chart. The two instrument pens are so arranged that one crosses over the other. (See Figure 2).

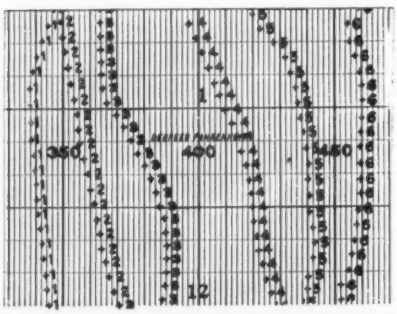


Fig. 2. Brown multiple record. * * *

A typical chart record from a 12 pen operation recorder, which automatically plots on a single roll chart a "two-position" record of 12 different moving parts of machinery or the like, shows on a time basis the frequency and duration of any operation it is desired to study. Records of stopping and starting of machines, or of opening or closing of switches can thus be conveniently obtained. When required, operation details can be recorded with some quantity, for example, the power taken by a group of motor-driven pumps, supply pressures, and periods during which the pump was running.

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An added value of the multipen recorder is that the instrument takes up less room than the several single instruments which it replaces. Similarly, the filing of multipen chart records is easier.

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In practice, the following points have to be observed: (a) choose the chart speed which is suitable as an average for all recorded values; (b) use distinct ink colours so that no mistake can be made as to the identity of each record; (c) obtain clear unblurred lines.

Instrument Pens

Where ink is used for recording on paper, the design of the pen deserves consideration. Much too frequently the chart records are blurred, which is neither to the credit of the instrument nor to the pen used. Makers' literature show a number of instrument ink pens made from material which is not corrodible by the ink such as nickel, monel and glass. Installation instructions usually explain in detail how to fill a pen, how to clean it, and how to exchange it.

Recording Ink

Requirements for instrument inks are basically contradictory. Ink in the pen is required to remain continuously liquid, but the written or printed diagram is expected to dry quickly. As primary material a mixture of glycerine and water is used and sometimes alcohol or dextrine is added to provide desirable ink quality. The frequent cleaning and refilling of a pen is a wise precaution in order to obtain clearly readable chart records. No hard and fast ruling can be given as to the time after which refilling becomes necessary, because much depends on the working conditions, on the type of pen used, and on the ink itself. Where the air in the instrument room is dirty or contains fluff or where higher air temperature prevails, obviously the cleaning of pens at frequent intervals is advisable. Needless to say, the ink should be stored in a cool dry place, but handy when it is required.

Inkless Records

Styluses on coated paper are widely used. As an example, a wax coating covers a dark red circular chart of the Servis recorder (Figure 3) and a metal stylus scrapes off the wax so that a thick red line appears when a car is in motion, or a machine is running. In other instruments electric sparks are produced at 3 to 5 kv between a metal stylus and a metallic support of the paper roll. Photo-sen-

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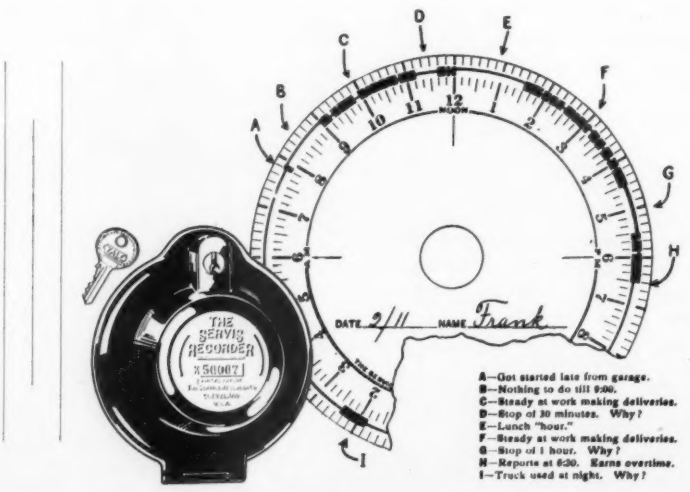

Fig. 3. Chart supervises truck movements. * * * * * *

The Technique of Wire Nail Making

by D. R. Even

This article, which originally appeared in Draht-Welt, was translated from German by Dr. Jerome W. Howe, Worcester, Mass., and is published here through the courtesy of Draht-Welt. The article covers the adjustment and maintenance of nail machines, their operation and observations on nail wire.

The nail today must be considered as an important item of everyday needs. Beyond its use in factories and woodworking shops, in the construction of houses and buildings of all kinds, and in various industries, there is no household where at least a small assortment of nails is not to be found, whether for use in making repairs or for the pursuit of hobbies.

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With the discovery and refinement of metals and metal working the nail took the place of fiber lashings and wooden pins.

The Earliest Nails Date from the Bronze Age

The first nails were used in the Bronze Age and were probably first made of copper. Such use must have been limited, because of the scarcity and value of the metal. Certainly they were hand-made and only for an occasional purpose.

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With the discovery of iron the production and use of nails was somewhat expanded, but primitive conditions could not have made possible any great output in these pre-historic times. With the extension of iron smelting, not only were they put to use in arms, implements and utensils of all kinds, but also the hand-manufacture of nails became more common. The production of nails remained, however, on a hand-work basis until the 1840s, and nail smiths were known even after that.

Early Nail Making Machines

The first machine for nail manufacture was built about 1810, and fifty years later the manufacture of nails experienced a rapid expansion, through the building of machines in special workshops. In the beginning only the production of the usual forms of wire nails out of square or round wire was possible, while the form of the head was of course varied at will. In the course of development, types of machines appeared for the production of all sorts of nails, including slate, shoe, roofing, horse-shoe nails and others, as well as machines for making nails out of sheet-metal strip.

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For decades the machines were constructed on the same principle; the R.P.M. being limited by the performance of the separate interacting working phases of the machine parts, as their activation resulted regressively through spring action, out of which a certain retardation resulted with each momentary retraction of the lever. Only after machines were constructed in which the control of the cutting and pressing levers by means of eccentric sheaves with guide grooves for the rollers were introduced was a notable increase in R.P.M. and consequent output possible.

High-Speed Nail Machines Revolutionize the Industry

A revolution in nail manufacture followed the introduction of high-velocity nail presses in the 1920s, in which the control of all machine parts including the upsetting slides was automatically accomplished. Now the R.P.M. was limited principally by physical and static factors. And improvements were continually made in these machines.

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Operators had to learn by experience what a machine could produce over an extended life. Overloading had to be avoided. Maximum lengths, too large heads, too thick a wire diameter can ruin a machine after prolonged use, while with a more moderate rate of output such a machine might run satisfactorily for years without damage. With high R.P.M. the gyrating mass must be kept as small as possible so that the control elements only have to transmit the force for the several working phases, principally head-upsetting and pointing, without contributing any additional required force through their own gyrating mass, or very little. Therefore the machine parts must be well balanced. The production of too heavy lots overloads them and the bearings, bevel gears, rollers, crankshaft and cross-shaft do not long remain in good condition. Even if brief overloadings do not immediately show up faults, upon dismantling extensive erosion, deformation and cambers become evident.

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Several machine manufacturers are now making high-speed presses, complete and ready for use. While built for continuous production, overload must not be demanded of any machine, even the most rugged. Unfortunately often no attention is paid to this and the effects are noted with a resigned shrug of the shoulders.

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Machines are sent from the factories with an accompanying indication of the minimum and maximum capacities. They must not be set for the production of more than the maximum lot, especially if for the designated lengths a heavier wire or head is to be added. So tempting is an increased production through higher R.P.M. that these lots should be manufactured on machines of the next larger size. Such machines will then be underloaded, but there is no economic disadvantage here because the production is safe, whereas overloading can by reason of breaks and repairs upset

all capacity calculations.

* * *

In practice, wire nails of all kinds are machine-made. In order to remove adhering dirt and oil, burrs, adhering pointing scrap and give the nails a good polish, they are tumbled in a rotating six-sided sheet-iron drum holding 775 to 875 pounds, with the addition of dry beechwood sawdust, after which they are packed in packages, containers, cartons, folding boxes, chests or sacks, and thus made ready either for storage or shipment. These procedures are common and easy to adopt and supervise.

The Machine Operator Has a Difficult Task

Nail manufacture involves the installation of the machines and the production of satisfactory products on them. The operator has to keep them in proper adjustment, service and oversee them. The demand upon the operator is very great, for the high R.P.M. produces a large output, and in case of any failure of one or another machine, a mass of rejects results. In order to avoid this it is imperative that he keep his machines continually under observation and control. In time he brings his manipulations into a definite system as he learns the peculiarities of each machine, but he must maintain a constant vigilance.

* * *

His most important task is the installation of new tools, i.e., dies and knives, and adjustment of the machines for the production of a satisfactory nail, with respect to central position of the head on the shaft, its correct size and form, straight points and uniform, accurate lengths. He can learn this in a few weeks, without however becoming perfected in its routine. To recognize the reasons for the occurrence of mistakes and failures and to avoid these by means of a slight and often very simple adjustment calls for long experience. It is not enough merely to allow a machine to run and make nails; it must make faultless nails. Very often and for long periods, the help and advice of experienced fellow-workers and foreman are necessary, before trainees can become well trained in the service of a whole assembly of machines. They seem incapable of appreciating the true significance of noise and wobbling of machine parts, defects and breakdowns.

* * *

In many plants the operation of a great number of machines is managed by an expert operator; while other tasks, like replacement of wire, emptying containers, lubricating and inspecting, are left to other employees, mostly youngsters. This is all well as a temporary measure, but the better and simpler and more dependable plan is the provision of an expert mechanic at each machine assembly, for which he is responsible. By this means not only quantity but also quality of output is assured.

Arrangement and Adjustment of Nail Machine Tools

The arrangement of the tools for nail manufacture is schematically shown in the accompanying sketch.

* * *

Basis for the machine adjustment is the assembly of the pressing dies as a pair, one half being fixed and centered on the bore of the leveling piece set in the die block; the other half movable, and, with the wire led in, pressed against the fixed half. The wire now shows on the middle of the header, and if it involves a shaped head, as convex, diamond, cone, or dog-headed spikes, pins or the like, small corrections in the vertical or horizontal direction may be demanded because the negative in the header is not exactly concentric. With great eccentricity, however, the possibility of correcting is limited, as the wire displaced too far out of the middle of the bore will then be compressed against the edge of the bore hole of the sliding vane. Then the header must be discarded as useless.

Adjustment of the Pointing Knives

The pointing knives are positioned with respect to the wire at nearly the highest pressure stage and little by little adjusted to the correct horizontal and vertical cuts, then screwed to full cut, with care not to let the knives cut through when turning by hand, but only nearly so. It should be taken into account that with the machine running the pointing cuts are made with a great rapidity, so that the pointing scrap, which by hand-turning still appears, now sprays off, the nails falling down without beards. Then when the

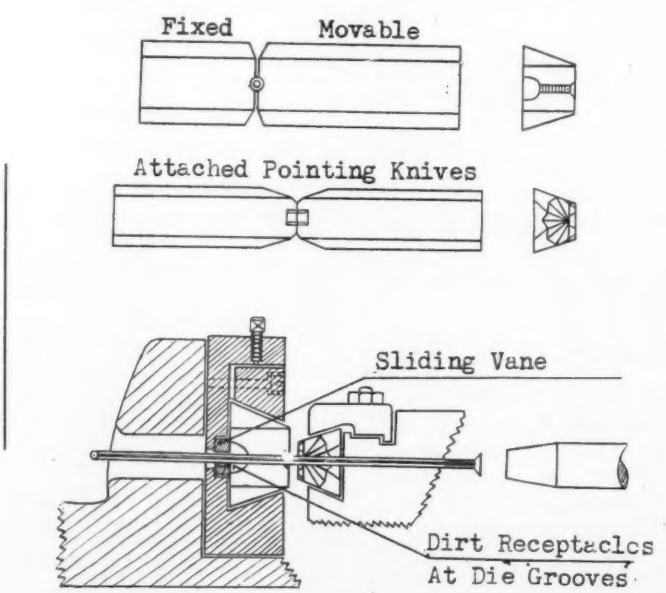

Diagram of Squeezing Operation, head upsetting, then advance a length, finally pointing cut, all continuous. * * * * * * *

cutting becomes less satisfactory, the knives must be again carefully adjusted to somewhat closer positions. If the knives have been adjusted for a full cut, in running the cutting edges will touch one another and soon will be damaged. If the pointing scrap adheres too strongly, then the knives will have to be changed. This will result from hasty, inaccurate adjustment of the cutting surfaces to each other, or if the cut is in any way oblique, or the pressure after correction too strong. It is in this feature that apprentices have greatest difficulty and cause much spoilage. The precision adjustment of the knives must under all circumstances take place by full rotation of the machine.

Centering the Nail Head

At the same time that this adjustment of the pointing knives is made the centering of the nail head must be accomplished. Often, after a careless adjustment, they will be found to be one-sided; then subsequent necessary correction requires shoving the dies away from the middle, or the re-setting of the already exactly adjusted knives, or these will be overstressed.

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When resetting of the dies and knives is required, in the setting up, a possible overhang of the head can be corrected through screwing up of the opposite die halves. At the same time knives, standing both to one side, should be pressed toward the middle, thus avoiding the necessity of a later re-setting of the dies and knives in order to correct the head. Too great a displacement of the head to one side can be corrected by displacement of the knives; a smaller displacement can be achieved, however, through a slight displacement of the dies, for which there is sufficient play in the bore of the sliding vane, without causing a bend in the shank.

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After considerable running time, a slight give of the movable die resulting from wear under the thumb-screw, results in the butt end intended for the head (which is longer or shorter according to the size of the upset head), being pressed somewhat obliquely to the pressing direction by the knives which have remained in unchanged position, and by this the head can then overhang in the same direction. Through a corresponding returning of the thumb-screw the movable die is brought back to the original pressing point, the butt end again diagonal, and with it the head again central, without having to reset the knives at all. With some experience such occasionally executed corrections require only a minimum of time, but insure a satisfactory quality during long runs.

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On one die half, advisedly only on the movable, a groove or gauge-point mark is introduced under the head, which is impressed upon the shank as a guide mark to facilitate the making of corrections. Heads oblique up or down may be traced to wear in the die block or smudgy grooves in the dies, whereby the butt end is pressed up or down out of the diagonal, or to a loose head stamp or loose hammer slides. They can be set concentric upwards or downwards through the addition of shims behind the die block. With loose stamp or hammer slides the head continues to vary. If the head stamp is tight, then it is the loose hammer slides that must be firmly fixed in place in order to assure regularly concentric heads. After insertion of the wiper and checking of tightness of all manipulated screws and nuts, the machine is now again ready for use.

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The adjustment of a machine for types with round, conical. pointed, domed, diamond, and especially profiled heads is more complicated, for here it must be aligned with the head stamp; this is still more the case for items with sheared end and head, as rivets, spokes, swivel pins and the like, where the butt end of the wire must for the most part be more or less oblique, in order to get the head concentric. In the alignment of dog-headed spikes, without help of an experienced operator, an inexperienced worker, who may be well accustomed to conventional kinds of pointed nails, finds himself lost.

Kinds of Wire Required

As raw material for nail manufacture for wire nails of all kinds with heads up to 2½ diameters, smooth wire of basic Bessemer steel, drawn through soap or grease, will serve. Mechanically descaled wire still shows sporadic spots of scale which hinder smooth cutting of the pointing knives and cause adhering point scrap. A good coating of lime before drawing remedies this. Such wire is of equal quality with pickled wire for the making of wire nails, but it may be that the descaling was carried out too superficially, and the wire after descaling still shows too much scale, which draws out in long streaks on the surface of the wire and leads to rapid wear of the dies. The same is true of poorly pickled rod. Such wire is not suitable for nail manufacture. any more than for galvanizing or any kind of welding.

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The so-called pipe-wire is an open-hearth wire of better quality, annealed, with a draft after annealing. It serves as material for production of steel roofing nails with heads of 3½ to 4 diameters and of other kinds of nails with specially large heads. Complete annealing is very important for such nails. The annealing pot should remain for an hour in the furnace after annealing temperature is reached to ensure good annealing of all the coils. The old drawn surface is then completely oxidized, the wire comes out of the pickle clean and smooth, while from insufficient annealing the remnants of the old surface skin are streaked along the wire and interfere with the cutting of the pointing knives and lead to rapid wear of the dies, knives and head stamp, which in turn influences importantly the quality of the product. Outside of irregular cutting of the pointing knives, discoloration of the head can also be joined with faulty annealing if the quality of wire does not prove of too high tensile value.

(*Please turn to page* 574)

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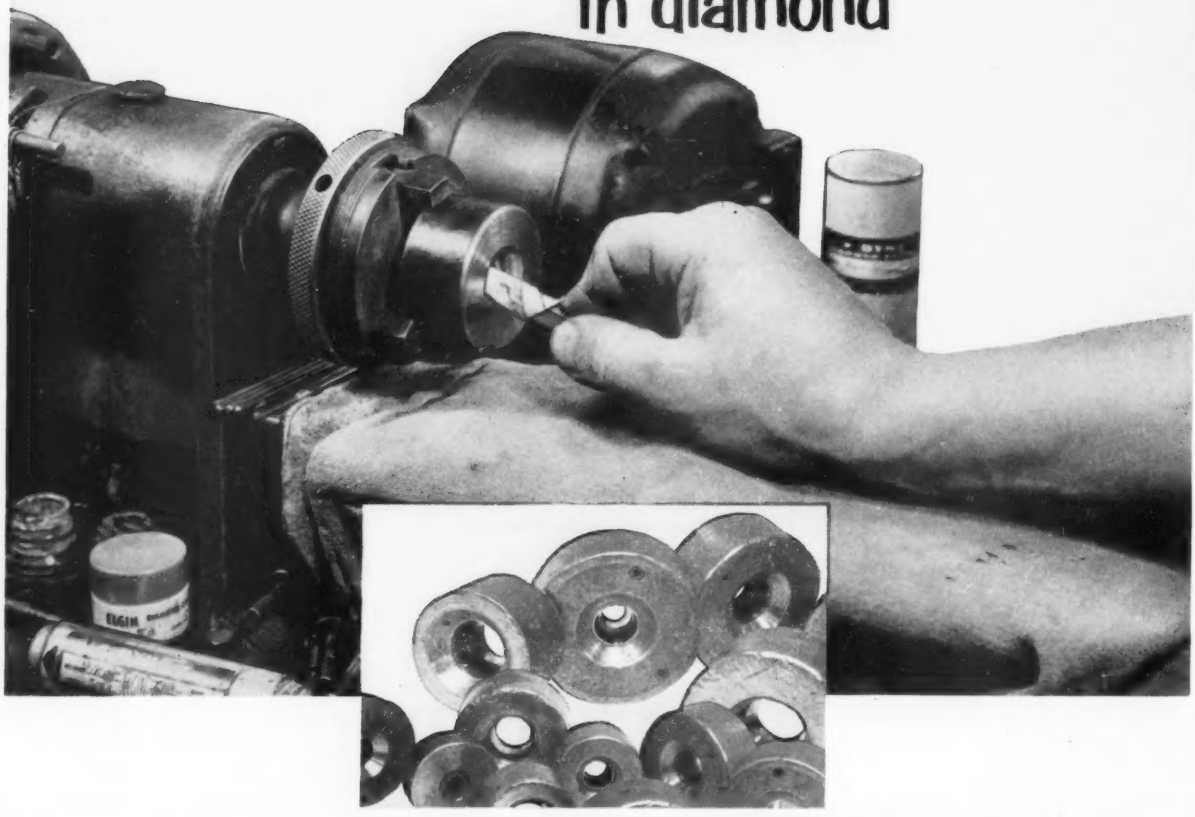

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Some Considerations on the Use of High Density Polythene in the Cable Industry

by D. Grant
Plastics Division
Imperial Chemical Industries Ltd.
Welwyn Garden City, England

This paper was presented at the Fifth Annual Wire and Cable Symposium of the Signal Corps on December 5, 1956, at Asbury Park, N. J.

Introduction

Nearly twenty years ago, a new insulating material, polythene, was introduced to the cable industry. The first use for this material was as a dielectric for submarine and high frequency cables, particularly in radar equipment, and in 1939 some 200 thousand pounds were produced. Since then, there has been a steady increase in its usage as a high frequency insulant, and in addition its unique combination of properties has led to its replacing conventional materials in a very wide field of applications. The current world usage of polythene by the cable industry is approximately 50 million pounds per year, and it is now recognized as one of the basic raw materials in this industry.

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The type of polythene which has gained this recognition lies in the density range 0.915 — 0.925, and this we will refer to as "conventional polythene." In the past three years, the range of polythenes has been extended by the introduction of polymers of higher density. These high density polythenes, as they are generally termed, are at present available only in limited quantities, being produced on a pilot plant scale. The range of densities available in these new polythenes is from 0.935 — 0.965.

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Until the introduction of these new polythenes, all manufacture was based on the high pressure process developed by Imperial Chemical Industries Ltd., but now some of these high density polythenes are produced at much lower pressures using newly discovered catalyst systems. There are probably three broad methods by which these polymers can be produced, and they may be summarised as follows:

Process	Catalyst System	Probable Density Range
High pressure	Free Radical	0.900 — 0.955
Low pressure	Metal Alkyls	0.945 — 0.955
Low pressure	Supported Oxide	0.955 — 0.970

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The first process is that which was discovered and is operated by Imperial Chemical Industries Ltd. The second is the Ziegler process and the third is covered by patents in the name of the Philips Petroleum Co. and Standard Oil of Indiana.

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There is now available a wider spectrum of polythenes than ever before, each with different characteristics, and so as to be able to assess the potentialities of these materials for the cable industry, it is necessary to consider their specific properties. In this paper we describe some of the properties of three high density polythenes, Polythene B, Polythene C and Polythene D, having densities of 0.94, 0.95 and 0.96 respectively, and after considering these in relation to conventional polythene, Polythene A, we indicate some of the possible applications where they may show up to advantage.

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The data presented here was obtained on a limited number of samples which are representative of polythenes of particular densities. The processes used to produce these materials are only important in that they provide the simplest route to those densities. The properties of these polythenes are related to their molecular structure, which in turn determines their densities, and it is on the basis of density that they should be compared.

Electrical Properties

Basically high density polythenes have the same electrical properties as the conventional material. (See table below)

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The power factor of Polythene B remains below 0.0002 up to 10^8 c.p.s. and changes little with frequency, as can be seen from Fig.

	Polythene B	Polythene A
Density	0.94	0.92
Dielectric constant at 20°C. (50 - 10^{10} c.p.s.)	2.32	2.28
Volume resistivity at 20°C.	$>10^{19}$ ohm cms.	$>10^{19}$ ohm cms.
Surface resistivity at 20°C.	$>4 \times 10^{14}$ ohm.	$>4 \times 10^{14}$ ohm.
Dielectric strength at 20°C. (50 c.p.s.)	1000 v./0.001 in	1000 v./0.001 in

(B.S.S. 771 test. Specimen 0.030 inch thick)

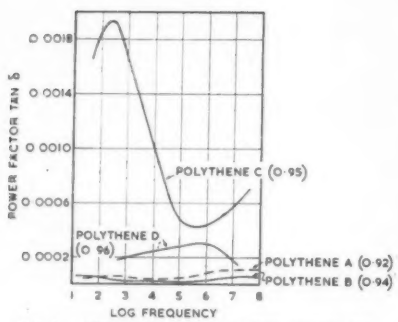

FIG 1. POWER FACTOR - FREQUENCY CURVES FOR HIGH DENSITY POLYTHENES, AT 20°C

1. This figure compares the power factor curves of Polythene A, B, C and D over a range of frequencies. Polythene C (density 0.95) has a higher power factor over the whole range of frequencies and an unusual peak at low frequencies. This inferiority would appear to be due to the presence of residual catalyst, and it can be shown that the power factor is, in fact, highly dependent on the amount of residual catalyst in the polymer (Fig. 2). The values in this latter figure were obtained on range of samples made by the second type of process described above.

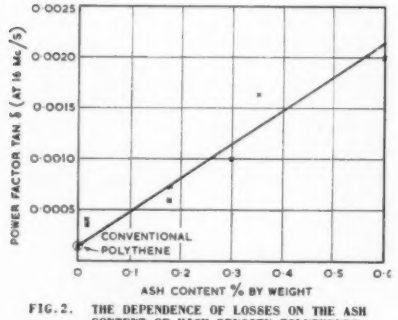

FIG. 2. THE DEPENDENCE OF LOSSES ON THE ASH CONTENT OF HIGH DENSITY POLYTHENES MADE USING A METAL ALKYL CATALYST SYSTEM.

High density polythenes made by the high pressure process using a free radical catalyst have outstanding electrical properties similar to those of conventional polythene, as in fact do polythenes made by the low pressure processes provided they are free from catalyst residues.

Physical Properties

Heat Resistance: The increased density of the new polythenes is due to their having a more linear molecular structure compared with conventional polythene, and this confers on them higher crystalline melting points and improved heat resistance. As the density increases, so does the resistance to deformation at elevated temperatures, as can be seen from the Vicat Softening Temperature Curves in Fig. 3 where the penetration of a 1 mm. square needle under a load of 2 kg. is plotted using a constant rate of increase of temperature of 50°C. per hour.

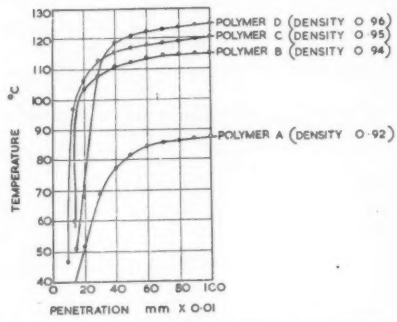

FIG. 3. VICAT SOFTENING TEMPERATURE CURVES.

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The stiffness modulus and creep characteristics at elevated temperatures also show quite markedly the improvement with these new polythenes. The histograms in Fig. 4 indicate the increase in stiffness which can be expected from a polythene of density 0.94. At 60°C. this polymer is as stiff as conventional polythene is at room temperature.

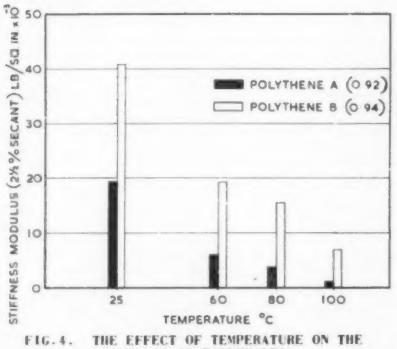

FIG. 4. THE EFFECT OF TEMPERATURE ON THE STIFFNESS OF POLYTHENES.

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Low Temperature Properties: As well as having improved heat resistance, high density polythenes also appear to have excellent low temperature properties. Using the A.S.T.M. low temperature brittle point test on polymers of density 0.94 — 0.96, it is generally found that the low temperature brittle point is below —70°C.

On the basis of experience with conventional polythene, such results would be taken as an indication that the material would give satisfactory service in the most stringent conditions of cold. With most polymers, a test of this type in which the specimens are flexed at low temperatures will exaggerate any tendency to brittleness, but with high density polythenes this is not always the case and the significance of this type of test in relation to the performance of a cable is open to question.

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Some high density polythenes which have been tested under much the same conditions of flexing are quite brittle at room temperature, whereas at reduced temperatures on this test they did not break. The reason for this is not altogether clear, but may be due to a more perfect surface on high density polythene samples. With conventional polythene there is a general correlation between molecular weight and low temperature brittle point, the higher the molecular weight the lower the brittle point, but recent work by Turner (Ref. 1) has shown that by varying the method of specimen preparation a range of over 50°C. could be obtained for the low temperature brittle point of a particular resin. If a very shallow notch is put in the high density polythene specimens then the temperature at which they fracture using this test is very much higher than otherwise. High density polythenes appear to be very much more notch sensitive than conventional polythenes, and this, of course, must be taken into account when assessing the practical implications of test results obtained on the low temperature brittleness test.

Mechanical Properties

The yield stress, ultimate tensile stress and stiffness of these new polythenes are dependent on and increase with the density (Fig. 5), as would be expected. The elongation at break of polythene is thought to be mainly dependent on molecular weight rather than density, but test data indicates that

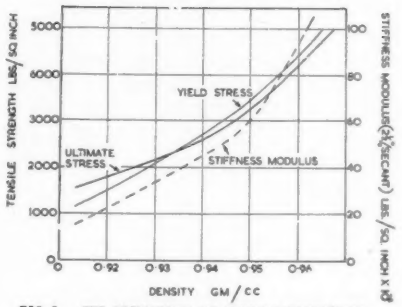

FIG. 5. THE DEPENDENCE OF TENSILE PROPERTIES AT 20°C ON THE DENSITY OF POLYTHENES.

both factors are important with high density polythenes (Fig. 6).

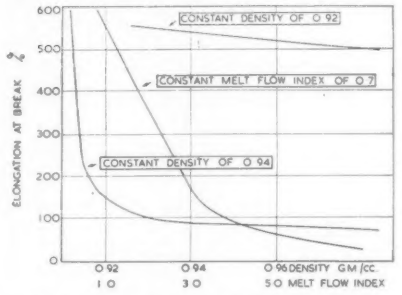

FIG. 6. THE DEPENDENCE OF ELONGATION AT BREAK AT 20°C ON DENSITY AND MELT FLOW INDEX. (GAUGE LENGTH 1", RATE OF SEPARATION OF CLAMPS 20 INCHES/MINUTE)

The elongation at break is also highly sensitive to the rate of straining (Fig. 7). Conventional polythene does not show this dependence on rate of straining to any significant extent, and it is considered that the very low elongation at break obtained at high rates of strain with high density polythenes, is evidence of a tendency to be brittle. Conventional

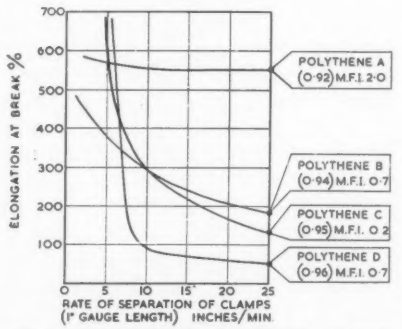
ELONGATION AT BREAK %
POLYTHENE A (0·92) M.F.I. 2·0
POLYTHENE B (0·94) M.F.I. 0·7
POLYTHENE C (0·95) M.F.I. 0·2
POLYTHENE D (0·96) M.F.I. 0·7
RATE OF SEPARATION OF CLAMPS (1" GAUGE LENGTH) INCHES/MIN.

FIG. 7 THE DEPENDENCE OF ELONGATION AT BREAK AT 20°C ON THE RATE OF STRAINING.

polythene does not show any signs of brittleness over the wide range of melt indices commercially available, indeed it is renowned for its flexibility. This evidence of a tendency to brittleness in high density polythenes is confirmed by laboratory impact tests. Although these tests in themselves are not sufficiently discriminating to show up small differences, they do confirm that high density polythenes are more brittle than conventional polythene, and that the higher the density the greater the likelihood of failure under shock loads.

Creep Characteristics

Short term creep tests and stress relaxation data indicate that high density polythenes have markedly superior creep characteristics compared with conventional polythene. For a given stress at 20°C., the creep of Polythene B will be approximately half that of Polythene A, and for the same strain criteria it should be possible to use about twice the stress rating (Fig. 8).

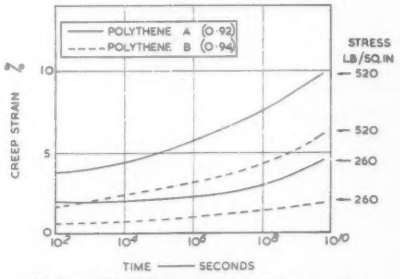

FIG. 8 CREEP CURVES FOR POLYTHENE AT 20°C

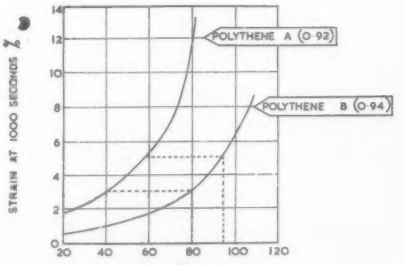

FIG. 9. CREEP CURVES FOR POLYTHENE AT A STRESS OF 260 LB./SQ. INCH OVER A TEMPERATURE RANGE OF 20 - 100°C.

The effect of temperature on the creep strain of these two polymers is shown in Fig. 9 where at constant time and under stresses of 260 lb./sq. inch., the strain is plotted over a temperature range 20 - 100°C. At 80°C. the creep rate for Polythene B is substantially less than for Polythene A at comparable stresses, and these short terms tests would suggest that if the creep of conventional polythene is satisfactory under service conditions between 40 - 60°C., then a comparable working range for Polythene B would be 80 - 95°C.

Environmental Stress Cracking

The cracking of conventional polythene when stressed in certain active environments has been the subject of extensive study, and a standard test is in existence which correlates broadly with failures in the field (Ref. 2). This test has shown quite conclusively that the lower melt index or high molecular weight conventional polythene resins are more resistant to failures of this type, and the same applies to high density polythenes using this test. Bending the test strips of the usual ⅛" thickness causes severe cold drawing with high density polythenes, and we have therefore reduced the specimen thickness to 1/16" when using this test for these materials. Fig. 10 shows the effect of melt flow index and Table I the effect of density on the cracking time using this thinner specimen. The results for the highest density material may not be significant since, even at 1/16" thickness the test specimens were cold drawn on bending.

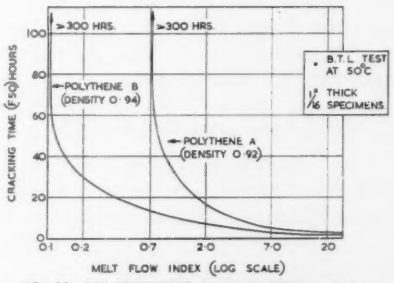

FIG. 10 THE DEPENDENCE OF ENVIRONMENTAL STRESS CRACKING ON MELT FLOW INDEX.

Table 1.

The Environmental Stress Cracking of High Density Polythenes

Polythene	A		B	C	D
Density	0.92		0.94	0.95	0.96
Melt Flow Index	2	0.3	0.38	0.2	0.67
Time for first failure	2.5	>300	6	31	5
Time for 50% failures	3.5	>300	22	38	5

These results show the relationship between melt flow index and the environmental stress cracking of high density polythenes, and they indicate that for a similar melt flow index conventional polythene is more resistant to failures of this type.

Because of some unaccountable fractures during aging and creep tests, the stress cracking of high density polythenes has also been investigated at elevated temperatures. These tests have been carried out using a miniature Bell Telephone Laboratories' environmental stress cracking test in which the dimensions of the apparatus and specimens were exactly half scale. Instead of a surface active agent environments such as air and distilled water have been used, and some very startling results obtained.

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When high density polythenes are maintained under stress at a temperature of 80°C. they develop cracks in a comparatively short time, and the higher the density the more rapid are these failures. Carrying out these tests in vacuo or with an anti-oxidant incorporated into the polymer does not make any significant difference, and it would thus appear that these failures are due to a so far undetected physical change which occurs at these elevated temperatures rather than to an oxidation effect. No change in crystalline structure has been detected but further investigation is in progress to determine the cause of these failures. The results obtained using this miniaturized B.T.L. test are summarized in Table 2.

Oxidation and Weathering

The deterioration of electrical and mechanical properties which occur when polythene is maintained at elevated temperatures or subjected to ultra-violet radiation is well-known (Ref. 3).

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It is believed that the thermal oxidation of polythene initiates at points of weakness in the polymer structure such as tertiary hydrogens or pendant methyl groups and the process then becomes autocatalytic (Ref. 4). This same type of mechanism can also account for photo-oxidation. On the basis of infra-red absorption evidence, high density polythenes can be shown to be less branched than conventional polythene and so contain fewer centres from which the oxidation mechanism can start.

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These new materials should therefore be less susceptible to oxidation at elevated temperatures and this appears to be so in air at 100°C. Fig. 11. These measurements of oxygen uptake have been made on 0.005 inch thick film pressed from the polythene granules without the addition of any anti-oxidant.

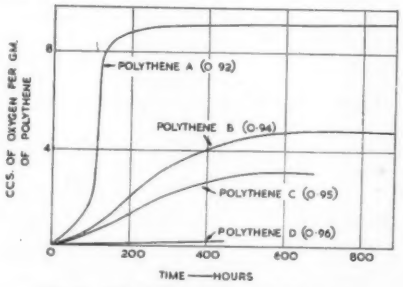

FIG. 11. THE OXYGEN UPTAKE OF HIGH DENSITY POLYTHENES IN AIR AT 100°C.

Table 2.

Stress Cracking of High Density Polythenes

	Stressed in Air, Cracking Time, Hours			
	at 30°C		at 80°C	
	First Failure	50% Failures	First Failure	50% Failures
Polythene A	>500	>500	>500	>500
B	>300	>500	>300	>500
C	>230	>500	119	143
D	67	90	5	5
	Stressed in Distilled Water, Cracking Time, Hours			
	at 30°C		at 80°C	
	First Failure	50% Failures	First Failure	50% Failures
Polythene A	>500	>500	>500	>500
B	>300	>500	>500	480
C	>250	>500	29	38
D	67	126	14	14

Further measurements have been made with 0.1% of the anti-oxidant diphenyl-p-phenylene diamine incorporated by milling on an open mill at 160°C. In air at 78°C. the anti-oxidant inhibits oxidation in all four polythenes and there is no significant uptake of oxygen over a period of 800 hours. In air at 100°C. the incorporation of anti-oxidant into conventional polythene, Polythene A, gives a marked reduction in the rate of oxidation and an induction period of over 600 hours. Polythene B has a similar long induction period with the anti-oxidant incorporated, but the two polymers made by the low pressure processes instead of being afforded protection by the D.P.P.D. show an increased oxygen uptake, Fig. 12.

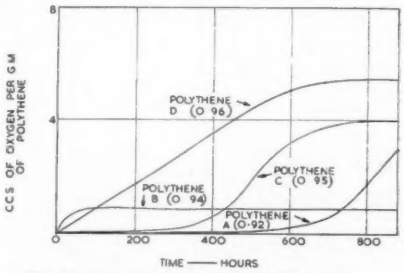

FIG. 12. THE OXYGEN UPTAKE OF HIGH DENSITY POLYTHENES CONTAINING 0.1% D.P.P.D. IN AIR AT 100°C.

This deterioration in resistance to oxidation in the presence of an anti-oxidant, as shown by these tests, is difficult to explain, but it would appear that the mechanism for this increased oxygen uptake is different from that causing oxidation in conventional polythenes. An indication of this was given by Jones and Boeke (Ref. 5), who found that at 150°C. a high density polythene (density 0.96) which was essentially free from branching, had a greater oxygen uptake than a highly branched conventional polythene. This deterioration may be attributable to a reaction between residual catalyst in Polythene C and D and the anti-oxidant, or perhaps to some structural change due to the milling process. The effect may be similar to that observed with certain metallic ions, such as cobalt, which when used for pigmenting polythene accelerate oxidation. This emphasizes the necessity for freedom from even the slightest trace of catalyst residues.

Accelerated weathering tests have been carried out by exposing samples containing 2% of well dispersed channel black to the radiations of a 550 watt U.V. lamp. Tensile test specimens were stamped out using a B.S.S. 903 Type C cutter, and these specimens were placed at a distance of 10 cm. away from the lamp. The deterioration due to exposure to ultra-violet light is usually assessed by measuring the low temperature brittle point of the specimens, but in view of the anomalous results already mentioned when using this test, it was not considered a satisfactory method for these polymers. Instead, the samples have been subjected to a tensile strain at a rate of 20″/min. using a 1″ gauge length, and the elongation at break has been taken as the measure of deterioration. The results obtained over a period of 800 hours' exposure are plotted in Figs. 13 and 14. The former

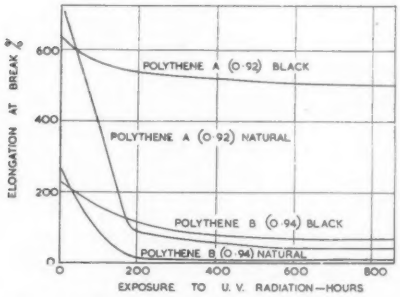

FIG. 13. COMPARISON OF THE ACCELERATED WEATHERING OF CONVENTIONAL POLYTHENE AND A HIGH DENSITY POLYTHENE. (GAUGE LENGTH OF TENSILE TEST SPECIMEN 1″, RATE OF SEPARATION OF CLAMPS 20 INCHES/MINUTE).

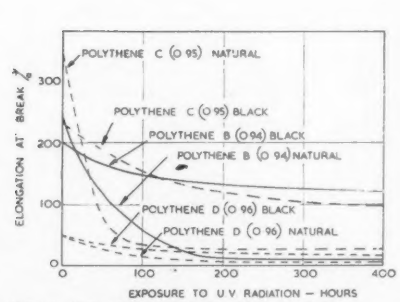

FIG. 14. THE ACCELERATED WEATHERING OF HIGH DENSITY POLYTHENES. (GAUGE LENGTH OF TENSILE TEST SPECIMENS 1″, RATE OF SEPARATION OF CLAMPS 20 INCHES/MINUTE).

curves compare conventional polythene, Polythene A, with Polythene B, both in the natural unprotected form, and also protected by a uniform dispersion of carbon black. It will be seen that carbon black affords protection to high density polythenes, but it is noteworthy that even a protected high density polythene is only equivalent to unprotected conventional polythene as assessed by this elongation at break test. In Fig. 14 the same results are plotted for the three high density polythenes, and it can be seen that after a comparatively short time of exposure they all show a similar deterioration.

High Density Polythenes for Specific Cable Applications

The electrical properties of high density polythenes are similar to those of conventional polythene, although at present some of the commercial samples available show an inferiority in power factor. It is to be expected that in time it will be possible to remove the catalyst residues which may be present in polymers made by some of the low pressure processes, and in considering the potentialities of these new materials, this will be assumed to be the case. Their dielectric constant is only marginally higher than that of conventional polythene and should not affect their application except in very special circumstances. The dielectric constant is still at a low level compared with that of other dielectrics. Under these circumstances, the advantages of high density polythenes are to be found in their improved mechanical properties and heat resistance.

Communication Cables

In the United Kingdom dry paper insulation of local distribution cables has been replaced to some considerable extent by conventional polythene, but this changeover has been limited by economic considerations. In this type of application it is largely the mechanical requirements of the insulant, and not the electrical characteristics, which determine the insulation thickness, the insulant having to withstand the strain, cutting, and abrasion of "twinning" and other assembly processes. To obtain an acceptable level of mechanical robustness, a radial coating of about 0.012″ is considered necessary with conventional polythene and this is both expensive and bulky. The increased mechanical strength and surface hardness of high density polythenes should certainly allow thinner coatings to be used (0.008″ radial thickness is envisaged) which, as well as showing direct saving in material cost, will be particularly advantageous when distribution cable runs in ducts and space is limited. Polythene insulated, polythene sheathed telephone distribution cables have many advantages over dry paper insulated, lead sheathed cable, particularly their highly satisfactory performance in corrosive environments and the low risk of overall failure due to ingress of moisture if the sheath is damaged. If high density polythene can be used to reduce the cost of the insulation, we may expect a considerable increase in the use of this type of cable.

★ ★ ★

The development of the use of cellular polythene in telephone cable may well be accelerated by the introduction of high density polythenes. These new materials in cellular form have a higher crush resistance and, consequently, thinner coating should be possible. Improved high temperature blowing agents and modified extrusion techniques will probably be necessary before these advantages can be fully exploited.

★ ★ ★

These new materials may make it possible to simplify the design of some special cables, such as field wire (D10 or WD1 type cables). The improved abrasion resistance of high density polythenes may enable a satisfactory cable to be designed without the need for a nylon sheath overall.

★ ★ ★

It is difficult at this stage to assess the full potentialities of high density polythenes as a sheathing material. They would have improved abrasion resistance compared with conventional polythene, but their increased stiffness

(*Please turn to page* 575)

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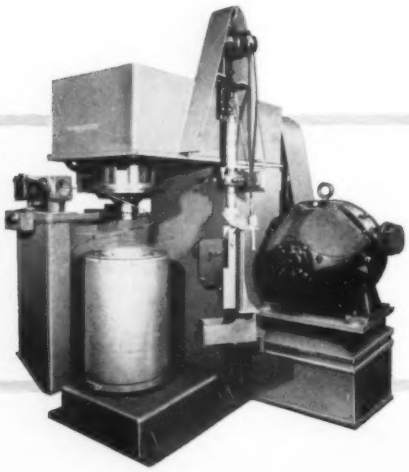

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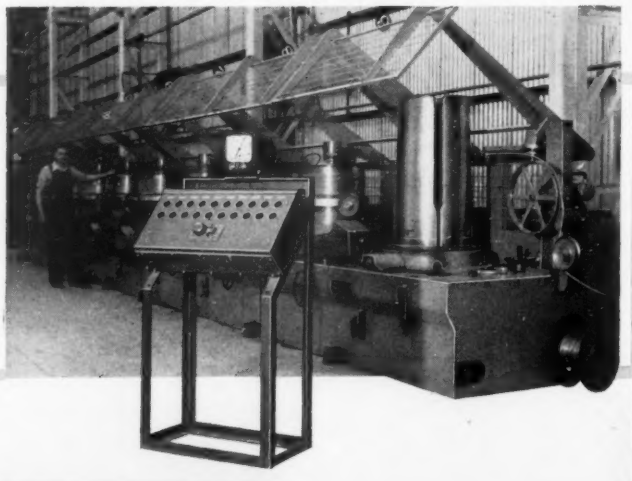

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Measurement of Die Wear by Radioactivity

by Winfrid Dahl and Werner Lueg

This report of The Max Planck Institute for Iron Research, Paper No. 656 (Report No. 64 of the Committee for Wire Working of the V.D.E.) appeared in a recent issue of Stahl und Eisen, Germany, and was translated for Wire and Wire Products by Dr. Jerome W. Howe of Worcester, Mass.

The authors describe a procedure for the determination die wear in drawing wire, in which dies are used that have been irradiated in an atomic pile and made radioactive. Different lubricants were used with these activated dies, which were then put in solutions where the radioactivity was measured by means of a scintillating counter. It was discovered that under otherwise equal conditions the wear of the dies with the use of soap and an alkaline carrier was about 3 to 4 times greater than in drawing with machine oil and a lime carrier.

An accurate knowledge of die wear is of great importance to wire drawers. At the present time, with machines running at higher speeds, the time lost in changing dies is significant. Consequently along with the testing of lubricants to reduce the required drawing force, the question of diminishing die wear takes first place.

* * *

Before going into the matter of measurement of wear in wire drawing, a brief review will be given of the processes by means of which tests of lubricants can be made in the laboratory. **O. Beeck, J. W. Givens** and **E. C. Williams** describe a process (Proc. Royal Soc. of London, 1941) by which the steel balls in a four-ball apparatus are drawn over a thin sheet of another metal, and the time determined for complete abrasion of the latter. By another method (C. B. Davies; Ann. New York Acad. Sci., 1950/51) the abrasion is determined chemically. A cylindrical pin ending below in a hemisphere is moved through copious lubricant on a plate. The lubricant is then examined chemically to determine its content of abraded metal. The accuracy is given as within 2% with an abraded quantity of 2×10^{-5} grams.

* * *

The use of radioactive metals in wear researches was described by **E. Rabinowicz** in British Journal of Applied Physics, Supplement 1, 1951. Together with **D. Tabor** (same journal for 1953) results were reported which were evidenced by interpretation of auto-radiographs. The method of procedure consists, according to **C. B. Davies** (see reference above) of a metal pin that rubs against a plate. By this method it is possible to clarify several fundamental questions. Yet the relationships between wire drawing and the procedures described above are very different. Therefore it was necessary to discover, by other techniques, which of them can be used to measure the wear during the drawing process.

* * *

The wear from drawing can be traced since the enlargement of the dies can be measured and the quantity of wire drawn can be set in relation to the enlargement. In order to get an enlargement of about 0.01 mm., at least 10 km. of wire must be drawn. This rules out this method for a comparison of different lubricants and lubricant carriers and for the laboratory research.

* * *

J. C. E. Button, A. J. Davies and **R. Tourret** (Nucleonics 9, 1951) used activated dies for their investigations. The abraded particles of the die found on the surface of the drawn wire were thus radioactive. In order to measure this activity the drawn wire was then coiled about a counter tube. By this investigation it was determined that the abrasion dust was not evenly distributed over the length of the wire and that different lubricants made no difference. The investigators traced this unsatisfactory result to the unfavorable geometric relations in the measurement, wherein only the activity on the part of the wire surface turned on the counter tube was measured. A disadvantage of the method lies also in that no calibration is possible, so that a numerical evaluation can be only very roughly obtained. Besides, the geometric arrangment is not exactly reproducible.

A New Research Method

In the following, a method of investigation is proposed by which the wire, after being drawn through an activated die, can, together with the adhering radioactive abrasion dust, be brought into solution and the activity of the solution be measured. From this method it is to be expected that even the smallest abrasion particles will be detected and measured, so that short drawing periods can render plotable results.

Research Procedure: Activation of the Dies

The dies used were mostly of cemented carbide enclosed in a steel casing. In the tests here recorded the chemical composition of the die was 94% tungsten carbide and 6% cobalt. Activation was accomplished in the atomic pile at Harwell, England.

* * *

In order to make possible the measurement of the wear of activated dies, a least activity of such dies is needed as will correspond with the estimated amount of abrasion dust and the sensitivity of the measuring arrangements. The following considerations show how the radiation time can be determined in order to obtain this degree of activation.

* * *

By the radiation of tungsten carbide and cobalt by neutrons, the isotopes W185, W187 and Co60 result. W187 has a half-life period of 24 hours and is essentially dead after a storage of a few days. For the measurement, W185 and Co60 were therefore used. The most im-

portant characteristics of these two isotopes are given in Table 1.

Table 1. Characteristic Factors of Isotopes Co 60 and W 185

Isotope	Half-life period	Radiation	Effective Cross-section
Co 60	5.3 years	γ 1.1715 MeV γ 1.3216 MeV β 0.308 MeV	29.6×10^{-24} cm^2
W 185	76 days	γ 0.1337 MeV 0.69 MeV β 0.42 MeV	0.645×10^{-24} cm^2

The activity after a radiation time **t** is computed from Formula 1:

$$s = \frac{0.6 \times f \times \sigma}{3.7 \times 10^{10} \times A}\left(1 - e^{-\frac{0.693}{T}}\right) C/g$$

In the formula s is the activity in curies per gram (1 curie = 3.7 x 10^{10} impulses per sec.); **F** is the flow of neutrons in the atomic pile in number per cm^2 x **s**; **A** is the atomic weight, σ the effective cross-section in **b a r n s** (1 **b a r n** = 10^{-24} cm^2) and **T** the half-life period.

* * *

By a rough calculation in which the estimated abrasive dust and the sensitivity of the measuring arrangements are entered, the required activity comes out to a few mC/g. The die used in the investigation was accordingly subjected for 120 hours to radiation with a pile factor of 7.5. The pile factor states the flow of neutrons in 120 hours and varies according to the position of the specimen in the atomic pile. The pile factor 7.5 states that the specimen was subjected to the neutron flow of 7.5 x 10^{11} neutrons/cm^2 x **s** for 120 hrs.

* * *

From Formula 1 and the values given in Table 1 for the designated activation we get

$^{s}C_o = 10.9$ mC/g
$^{s}W = 1.95$ mC/g
mCs - milli-curie per gram

The measurement began about 30 days after the end of the irradiation. In this period W 185 was already in part decayed. By the formula for the radioactive disintegration (as in Formula 2):

$$s = S_0 \times e^{-\lambda t} \text{ mC/g}$$

the activity for any period **t** can be computed. In the formula s_0 is the required activity at the termination of irradiation, **s** the activity at the end of time **t** and λ the disintegration constant with

$$\lambda = \ln \times 2/T$$

From this calculation it is learned that after 30 days the activity of W 185 has diminished to 1.45 mC/g. The activities of the elements add up corresponding to the combination. The activity of carbide **G1** is therefore 10.9 x 0.06 + 1.45 x 0.875 = 1.92 mC/g.

* * *

Along with the die a lamina of the same carbide was activated under the same conditions. This lamina serves for calibration.

Die Experiments

The activated die of 17 mm. diameter and 13 mm. long had a hole of 1.99 mm., an opening angle of 11.8° and a taper length of 0.5 mm. After irradiation it was shrunk into a steel casing in customary manner, and then installed for the first research series in the third draft of a continuous wire drawing in which a patented steel wire of about 142,000 lbs./sq. in. tensile strength was drawn down by the first draft from 3.98 mm. to 3.20 mm. and by a second draft to 2.44 mm. diameter. As lubricant carrier a mixture chiefly of alkali base was used, and a lubricant of needle-like drawing soap, as with this combination, according to **W. Lueg** and **K. H. Treptow**, a low friction value is obtained.

* * *

Before the beginning of test measurements an initial 1,640 feet of wire was drawn, and test specimens were taken from the end of this length. Six feet of the end was first cut off, and three test pieces each three feet long. Sixteen feet more were discarded and then two more test pieces (Nos. 4 and 5) were cut, each about three feet long. In this manner the uniformity of wear could be investigated.

* * *

In a second test series lime was used as carrier and machine oil as lubricant. The gauge and reductions were the same as for the first series. However, only 164 feet of wire was drawn, and the test specimens taken from the end in the same manner as before.

* * *

In further experiments with lime and machine oil as carrier and lubricant, a soft wire of basic Bessemer steel with about 0.5% C and a tensile strength of about 55,500 lbs./sq. in. and diameter of 7.00 mm. was used. This was drawn down in seven drafts to 2.34 mm. and then in the eighth draft drawn through radioactive dies. The final length of this wire was about 160 feet and test specimens were cut from the end in the same manner.

* * *

As the research of **E. Rabinowicz** in 1952 had shown, no fear has to be entertained respecting the loss of particles of abrasion dust through the reeling and cutting of the wire.

Preparation of Solutions

The test specimens were prepared in the chemical laboratory of the Institute by a procedure developed there. The three-foot long sections of about 2 mm. diameter wire were subdivided and boiled for 30 minutes in aqua regia. The resulting diameter was about 1.5 mm. so that pretty surely all the abrasion dust went into solution. The solution was now evaporated and absorbed with hydrochloric acid. The dissolved iron was then extracted with ether by the process of **H. Malissa** and **H. Brockmann.** Finally the remaining solution was reduced to a few milliliters and racked in test bottles.

* * *

A 6.88 milligram chip of the radioactive carbide lamina served as calibration specimen. This chip was dissolved in a mixture of nitric and hydrofluoric acid, and the resulting solution diluted to 1 liter. Of this diluted solution 3.9 milliliters, corresponding to the liquid volume of the wire specimens, were bottled. Further dilution of the calibration solution was deliberately dispensed with since the error in measurement is as much smaller, as the

number of impulses per unit of time is greater.

Measurement of Radioactivity

For the measurement a scintillation crystal, with an electronic counter (by **Frieseke & Hopfner Firm, Erlangen-Bruck**), was available. In the crystal, constituted of sodium iodide with small additions of other elements, scintillations were emitted through gamma and beta rays which were measured with a photoelectric cathode and magnified over a secondary electronic multiplier. The efficiency of counter tube of this crystal is definitely greater than that of a Geiger-Muller counter. The crystal has a bore hole 10 mm. in diameter and 32 mm. deep, surrounded by a strong lead shielding so that the inflow of cosmic ray radiation was largely excluded.

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Next in the preparation for the experiments, the most favorable sensitivity and voltage of the measurement connections was determined. The zero effect of the final adjustment was about 180 impulses per minute. As a blank test sample, a specimen glass with the same acid was used as for the solution of the test specimens.

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The error of an impulse measurement is given by the number of the measured impulses and, for 1,000 impulses, amounts to about 3.3%. As the number of impulses per minute by the measurements to be here carried out was very small, every measurment had to be extended over 20 minutes.

Auto-radiographic Photographs

In order to investigate the distribution of the abrasion particles, pieces of wire about eight inches long were laid end to end on Roentgen film. Preliminary tests showed that only with the most sensitive films would a visible density appear. The wires remained in the first trial seven and in the second trial fourteen days in contact with the film.

Results and Evaluation of the Research

The results of the series of measurements are collected in Table 2. The number of impulses per minute shown is the average value of several measurements. The number of impulses measured with the blank test sample has been subtracted.

Table 2. Activity Values of Wire Specimens

Specimen	Drawing process	Impulses per min.
1	3 drafts; alkali/soap	55
2		84
3		90
4		59
5		62
6	3 drafts; lime/machine oil	23
7		16
8		16
9		14
10		20
11	8 drafts; lime/machine oil	16
12		2540
13		12
14		dead
15		68
Calibration specimen		11,680

The deviation from the average value is at most about 10%. For this several reasons can be responsible:

(1) The zero effect is not constant. In the course of a series of measurements, which mostly extended over a whole day, fluctuations occurred similar in amount to the deviations from the mean value. It is possible to diminish the zero effect further through equivalent circuits so that such fluctuations will have less weight.

(2) The time for one measurement was still too short. For specimens that show a small activity, a lengthening of the experiment will lead to greater accuracy of the measurement.

(3) The investigated fluid volume was still too great and the number of impulses captured from the sodium iodide crystal therefore correspondingly small. Perhaps the volume of the test specimen may be still further reduced, so that the radiation can be still better utilized.

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By observation of the results it is recognized that the deviation of the different tests among themselves is greater than the given accuracy of measurement. In the first and second groups (tests 1 to 5 and 6 to 10) the fluctuations amount to about 30%. That is not surprising, when it is considered that in wire drawing, to and fro weldings between wire and die occur and thus particles of tungsten carbide are suddenly torn out of the die. Variations in the activity between successive tests therefore are attributable to this irregularity in wear.

The Wear Varies With the Lubricant

The results of the investigation show further that the wear by use of a drawing soap with an alkaline lubricant carrier is three or four times as great as when the drawing is with use of machine oil and lime as carrier. This is contrary to the findings of Lueg and Treptow, whose experiments showed that the use of soap gave a lower wear value than machine oil and lime.

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This may be explained in the following manner: by the former research results it was not shown that a higher friction coefficient necessarily had a stronger wear as a consequence. So **A. E. Ranger** and **J. G. Wistreich** advise (Journal of the Petroleum Inst., 1954) that the friction coefficient depends essentially, with high pressures, upon the properties of the lubricant, while the wear is conditioned by the number and magnitude of the weldings. According to Ranger and Wistreich the friction coefficient therefore is not a measure of the quality of a lubricant, if its wear lessening properties are in question.

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In the view of **R. Ramsauer** and **K. L. Wolf** the amount of wear depends upon the interfacial tension of the lubricant. These writers affirm that with addition of fatty acid to a lubricant with mineral oil base, a stronger abrasion occurs while at the same time the friction coefficient is diminished. The fatty acid addition reduces the interfacial tension of the lubricant and, in the opinion of these writers, small tears and splits can be opened out through slighter penetration of the lubricant.

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H. Kuntze and **A. Pomp** also, in their work under similar research conditions, with steel wire of 12 Cr Ni 18 8 with iron oxalate coating, find a greater wear than by the use of common salt—lime as a lubricant carrier. The friction coefficient of the iron oxalate coated wire is on the other hand definitely lower than with the lime coating.

By investigations of the Institute not yet made public, it was further determined that various lubricants, as for example mineral oil and rape oil, give equal values of traction in the first four to the fifth draft. The better quality of the rape oil first shows itself in the last drafts, in which the lubricant carrier was extensively used and higher pressures obtained. Accordingly, it is to be expected that by measurements of wear other results will be found if the number of drafts is increased. The third group of experiments (tests 11 to 15) show the results in which radioactive dies were used in eight drafts. The activity values of the individual test specimens of this group deviate from one another by a factor of about 200. Strong weldings therefore occur which point to a break-down of the lubricant. In other experiments it was found that the traction fluctuated greatly in these drafts. This finding also shows that the lubricant fails, i.e., that strong disturbances of the drawing process occur.

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A numerical indication of the abrasion of the carbide by the radioactive process is not possible when such varying values occur within a group of tests. One can only ascertain the beginning of the severe abrasion. The drawing must then be discontinued because of the excessive strain upon the dies.

Evaluation of the Calibration Sample

With the standard sample solution the experiment can be evaluated numerically. As mean value of the first group of tests an activity of 70 impulses per minute resulted. In one liter of the calibration solution 6.88 milligrams of carbide are dissolved and 3.9 milliliters were taken for the measurement. The number of impulses per minute is 11,680 as shown in Table 2. The mean abrasion of the first group (alkali with soap) is therefore

$$G_1 \frac{70}{11{,}690} \times \frac{3.9}{1000} \times 6.88 \times 10^{-3}\ \text{gm} = 1.6 \times 10^{-7}\ \text{g/m}$$

With the second group of tests (line with machine oil) a mean impulse count of 18 per minute resulted, which gives for the wear G_2 4.1 x 10^{-8} grams per meter. The values of G_1 and G_2 thus obtained show that by means of this process extraordinarily small amounts of abrasion can be measured.

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This result moreover agrees with the research of Button, Davies and Tourret, which reported, as a rough estimate, an abrasion of 6 x 10^{-8} g/m in the drawing of copper wire. Most investigations in which the wear was determined from change in the die dimensions were carried out with steel dies. Thorough investigations of the wear of carbide dies in the drawing of stainless steel wire were described by **H. Kuntz** and **A. Pomp,** showing that the expansion of the dies was dependent upon the length of wire drawn. In order to compare the results reported herein with those of Kuntz and Pomp **(Stahl u.Eisen** Vol. 74 - 1954 - pages 1325/34) the expansion of the dies must be computed from the measured abrasion dust.

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For this computation it will be accepted that the approach and bearing sections are abraded equally. This is of course not quite accurate as at the mouth a ring formation is often observed, yet from the measurements of **D. G. Christopherson** and **H. Naylor (Wire Industry** Vol. 22-1955)as well as **J. G. Wistreich** (ibid.) who measured the dies before and after the drawing, it can be accepted that this assumption represents a good approximation.

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The volume V_1 abraded in the cylindrical part is computed as

$$V_1 = \frac{\pi}{4}(d_2^2 - d_1^2)\, z\ \text{cm}^3$$

where d_1 and d_2 are the diameters of the approach before and after drawing, and z the length of the approach section. As the difference between the diameters is very small a good approximation can be written $d_2 = d_1 + \Delta$ cm and by the calculation neglect the quadratic terms of Δ.

Thereby

$$V_1 = \frac{\pi}{2} d_1 \times z \times \Delta\ \text{cm}^3$$

For the bearing section, with similar approximation, the amount of abrasion can be expressed as

$$V_2 = \frac{F_0 - F_1}{2 \sin \alpha} \times \Delta\ \text{cm}^3$$

in which F_0 and F_1 are the entering and terminal cross-sections, 2α the die angle and Δ again the expansion in cm.

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According to **J. Hinnuber** the weight of the grade of carbide G1 is

$$\varrho = 14.6\ \text{g/cm}^3$$

The weight of the abrasion dust is therefore

$$G = \varrho V = (V_1 + V_2)\varrho$$
$$G = 1.35 \Delta g$$

★ ★ ★

In the first group of tests (alkali with soap) an abrasion of $G_1 = 1.6 \times 10^{-7}$ g/m was found. From this the expansion is computed

$$\Delta = \frac{G_1}{1.35} = 1.2 \times 10^{-7}\ \text{cm/m} = 1.2 \times 10^{-6}\ \text{mm/m}$$

This result shows that the expansion amounts to 0.012 mm if 10 km of wire is drawn. This is about the value which was found by Kuntze and Pomp for the drawing of alloy steel with a refined steel-bonder-188 coating as a lubricant carrier and calcium stearate as a lubricant with similar die dimensions.

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For the second group of tests (lime with machine oil) the abrasion dust amounted to 4.1 x 10^{-8} g/m. Corresponding to this the expansion was

$$\Delta_2 = \frac{4.1 \times 10^{-8}}{1.35}\ \text{cm/m} = 3.05 \times 10^{-7}\ \text{mm/m}$$

For a length of drawn wire of 10 km the expansion is therefore only 0.003 mm. That corresponds fairly well to the figure which **H. Kuntze**

(*Please turn to page* 573)

New Developments in Silicone Rubber for Electrical Tapes

by J. S. Hurley, Jr.
Silicone Products Department
General Electric Company
Waterford, New York

This paper was presented at the Fifth Annual Signal Corps Wire and Cable Symposium at Asbury Park, N. J., on December 5, 1956.

It has been said of silicones that more uses have been found for them in a shorter time than for any other material ever created by man. Time does not permit even listing the literally hundreds of applications for them in dozens of businesses and industries, but almost every industry uses silicones in some way, and even the baby enjoys his bottle more because of silicone rubber nipples.

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Prior to World War II, silicones were known only to a few people in industry and to a handful of researchers in the academic world. The war accelerated their development as industry sought to meet the need for new and better insulating materials to satisfy the Navy's demands for better reliability and dependability of shipboard electrical equipment.

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It is interesting to note that while the electrical applications were primarily the reasons for this intensive silicone research, it has been the so-called "by products" which have brought the name silicones to more people throughout the world today. Silicones are widely known for their use in consumer items. However, even though these consumer items are not of particular interest to the electrical industry, it is the use of silicones in wax and polishes, cosmetics, water repellents for textiles and masonry, and in industrial uses including mold release for the tire industry and anti-foams for various process industries that made possible the continuation of the developmental work to bring about new products which now offer such great promise in the electrical industry.

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The electrical industry could not have supported the silicone industry at its beginning only a dozen years ago, and these versatile materials might have been lost to us had not the chemical industry developed a very broad range of applications for all type of silicones.

★ ★ ★

The electrical industry has come a long way from the early days when the principal insulations were paper, jute, asphalt, mica, shellac, and other products. Certainly, mica and shellac are still very important materials in the industry, but the real advances have been in the synthetics.

★ ★ ★

Of the many new and improved materials available, silicone rubber in its many forms stands out as a type of insulating material offering to the electrical industry an extremely versatile product which lends itself to broad application and provides for new concepts in the use of insulating materials.

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First of all, let's examine some of the properties which make silicone rubber a useful product for the wire and cable industry, and the electrical industry generally. In many ways, silicone rubber is ideal for use in wire and cable because it possesses high temperature resistance, low temperature flexibility, good thermal conductivity, ozone and corona resistance, arc resistance, stable electrical properties, aging and wetting resistance. It is inert and is resistant to most chemicals encountered in wire and cable applications. The Navy uses a silicone insulated cable because silicone rubber does not leave a carbonaceous ash when it burns, but continues to maintain an insulating system. Thus, critical pieces of electrical equipment will operate under emergency conditions until suitable repairs can be made. With ordinary cable the insulation would burn out, the wires short, resulting in shutdown of equipment and serious operational delays.

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Originally, silicone rubber offered many problems in the manufacture and fabrication. But now silicone rubber compounds can be made on conventional equipment available thoughout the rubber industry and may be fabricated using standard or slightly modified methods of molding, calendering, kniving, dipping, and extruding.

Physical Properties

The present silicone rubber materials bear little resemblance to the earlier products. We now have silicone rubbers which possess physical properties far and above those which some of the original investigators of the materials felt was the upper limit for such products. They are now approaching in physical properties the strength of some of the other types of synthetic elastomers and we can see materials now which will equal and perhaps even surpass their organic counterparts. Figure 1 shows the range of properties now

Figure 1

Typical Physical Properties
Silicone Rubber

Durometer (Shore A)	30 to 90
Tensile Strength, psi	500 to 1400
Elongation, %	50 to 600
Compression Set, Method B, %	
22 hrs./158 F.	as low as 2
22 hrs./300 F.	" " " 7
22 hrs./350 F.	" " " 15
Useful temperature range, °F	-120 to + 600

available, and Figure 2 shows typical electrical properties which may be obtained through a wide variety of formulation. Each of these properties can be controlled to some extent through compounding.

Figure 2

Typical Electrical Properties
Silicone Rubber

(ASTM SLABS - 75 mil)

Electric Strength, vpm	400 - 500
Power Factor	.0035 - .0075
Specific Inductive Capacity	3.0 - 3.5
Volume Resistivity, ohm-cm	10^{14} - 10^{16}

Of great importance to all users of silicone rubbers is the marked improvement in the physical properties of silicone rubber. The graph shown in Figure 3 shows the improvement in stress strain properties of silicone rubber in terms of the tensile product. The tensile product is a term commonly applied in the rubber industry to represent the efficiency of a polymer-filler system. It is the product of tensile strength in pounds per square inch times the elongation in percent.

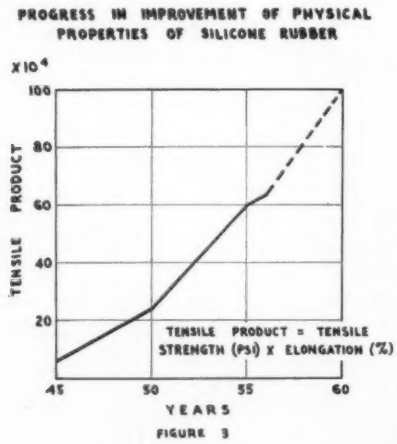


FIGURE 3

Previously, the top temperature limit for silicone rubber was about 500°F. We now have silicone rubbers which will exhibit normal characteristics up to 600°F. Silicone rubbers are available too, which remain flexible as low as -120°F. Thus, there are materials for use over an operating range of -120°F to 600°F.

Another important recent development is a silicone rubber with the same shrinkage as organic rubbers. This Class 300 silicone rubber is the first of its type which can be used in the same molds as an organic rubber. Its use makes possible closer tolerances and keeps cost down by reducing inventory of expensive molds.

★ ★ ★

Still another significant achievement is low compression set rubber without toxic additives. Previously, the low compression set properties exhibited by silicone rubber could be attained only by the use of such toxic additives as mercury or cadmium compounds.

★ ★ ★

But what does this have to do with wire and cable? It serves to emphasize the fact that silicones and particularly silicone rubber in its many forms and modifications is fitting into new applications because of its many usable properties. Resistance to temperature extremes is the property which leads to the rapid development of silicone rubber. But, it is the other properties such as low temperature flexibility, corona resistance, electrical properties which are maintained at elevated temperatures, thermal conductivity, chemical resistance and general inertness which has made it practical for use in many commercial applications.

★ ★ ★

Also, no plasticizers or inhibitors are added to silicone rubber to prolong flexibility and other properties under heat aging. Thus, the characteristics of silicone rubber are retained because of the rubber itself and not due to additives and extenders used with other synthetic elastomers which can break down or be driven out thus reducing the effective life of the rubber.

★ ★ ★

Of most importance to the electrical engineer is what happens at operating temperatures when he applies silicone rubber insulation. Figure 4 shows the voltage endurance of a silicone rubber insulated test bar using 140 mils of silicone rubber tape.

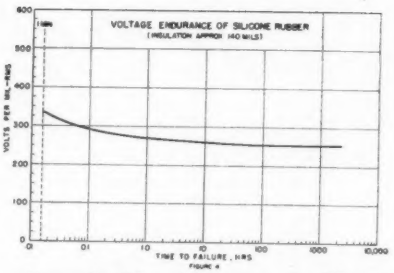


FIGURE 4

Conceivably, the use of silicone rubber can result in thinner insulation for motors and generators and cables as well because of its voltage endurance and long life. Thermal conductivity of silicone rubber, which is approximately double that of most organic rubbers, is another property of value to the engineer, and is of special interest in cable applications. A silicone rubber insulated cable would run cooler under the same load as compared to an organic rubber, or carry a greater load at the same temperature.

Silicone Rubber in Wire & Cable

Because of the increasing use of Class H insulated motors, transformers and auxiliary equipment cables must be developed which can be used with these machines under conditions of high ambient temperatures. It is necessary to connect such Class H equipment in the interior of the terminal box attached to the motor, and to the high and low voltage sides of the dry type transformers. Ambient temperatures at both points may be well over 100°C. Even enclosed switchgear operating in and around such equipment will be operating at such high temperatures. These severe operating conditions posed a challenge to the cable industry which was met with the development of a silicone rubber insulated power cable.

★ ★ ★

A description of the power cable developed for high temperature operation was described in a paper entitled "High Temperature Power Cable with Silicone Insulation" by **Mr. A. R. Lee** of the General Electric Company and **Mr. C. T. Hatcher** of Consolidated Edison Company of New York in an AIEE Transactions Paper presented at the Summer and Pacific General Meeting in San Francisco, June 1956.

Such cable is capable of operating at 125°C and will carry at least 50 per cent more current than a cable designed for operation at 85°C (Figure 5). Furthermore, the silicone rubber insulated cable will operate in hot ducts and under conditions which would severely degrade organic insulation.

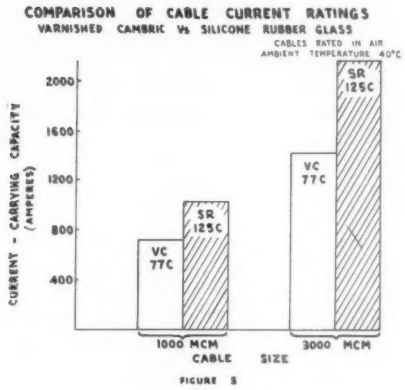


FIGURE 5

Silicone Rubber Tapes

Cable engineers designing new cables followed the lead of the U. S. Navy and investigated the properties of General Electric's SE-100 compounds. The SE-100 series of compounds are white silicone rubber products designed specifically for coating glass cloth for electrical applications.

★ ★ ★

It is not the intention of this paper to describe the properties of SE-100, which are well known in the industry. Rather, we propose to discuss the results of a new study on the product which was designed to provide more specific data to the cable industry.

★ ★ ★

As is the case in most studies of this type, it takes a great deal of time to collect this information, analyze it and put it in a useful form. The data are by no means complete but is presented here for further consideration by engineers who specify materials to insulate the larger power cables.

★ ★ ★

In setting up this testing program, an attempt was made to try to eliminate as many variables as possible with careful control on the specific variables under test in order that a direct correlation be made between the various specimens. Included in the study was SE-100 rubber on ECC-116 glass cloth with the carmelized or 111 finish. Compared to this is SE-100 rubber on ECC-116 glass cloth coated as received without any previous heat treatment. Also investigated were the effects of cure time and temperature as well as catalyst content on silicone rubber tapes.

★ ★ ★

Data has been obtained on the specific inductive capacity and power factor of a silicone rubber coated glass cloth cured in a commercial coating tower using 2 per cent benzoyl peroxide catalyst and a coating speed of 2 feet per minute, with a final cure at 500°F. All samples were sealed and sent to the testing area where the program was set up on samples which were conditioned as follows:

Condition A
48 hours, 50% relative humidity and 73°F.

Condition B
96 hours, 96% relative humidity and 73°F.

Condition C
4 hours at 105°C

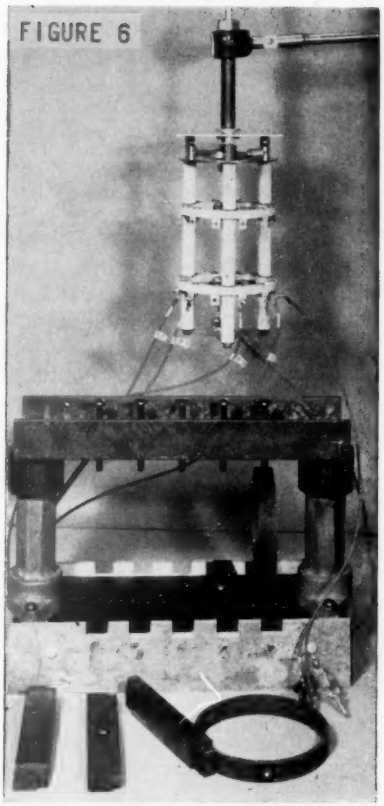
Condition D
4 hours at 105°C plus 48 hours at 50% relative humidity and 73°F.

★ ★ ★

The equipment used for this program is shown in Figure 6.

★ ★ ★

It consists of a special jig holding the pressure electrodes. The steel electrodes were 2.1 square inches and the test was carried out at 10 to 12 pounds/sq. in. The heavy channel frame becomes part of the guard circuit. A Schering bridge was used with tests made at a stress of 500 volts, 60 cycle. The jig is especially designed to fit into an oven and one sample of each test specimen was used throughout the test cycle. Thus, the sample was left under the electrode for the complete temperature cycle after any given conditioning. Power factor and specific inductive capacity were measured on these samples at 30°C, 80°C, 100°C, 145°C, after one half hour at 145° then back down the temperature scale 100°, 80°, and 30°C.



Specific Inductive Capacity

The data on the specific inductive capacity is shown on Figure 7. As can be seen, the specific inductive capacity of SE-100 varies at test temperature in the range of 3.6 at 30°C, to 3.1 at 145°C. The data also shows the effect on specific inductive capacity of the conditioning at 96% relative humidity for 96 hours. The value as measured at 30°C at the start of the cycle after high humidity conditioning is approximately 4, while

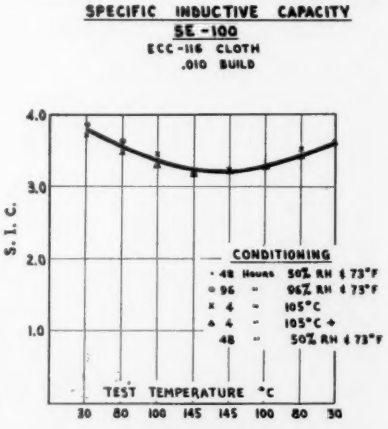


FIGURE 7

at 145°C the value drops to 3.1. It then returns to 3.6 when remeasured at 30°C, showing effect of drying of the specimen during the test cycle. It is interesting to note that this data is obtained on the glass cloth without heat treatment. The data on the sample using the carmelized cloth, while falling in the same range, shows less of a variation with temperature than the specimens made with the standard cloth. This was true of all the data under all the conditions tested. The difference does not seem to be significant, but obviously the data does show some slight effect of the carmelizing which in some cases may be an advantage.

Power Factor

The data on the power factor is shown in Fgures 8 and 9. All power

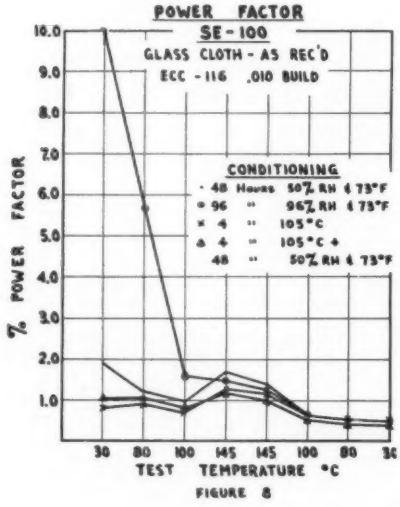


FIGURE 8

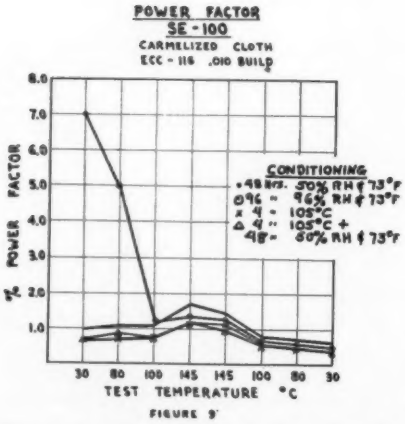


FIGURE 9

factor measurements, with the exception of those conditioned at 96% relative humidity for 96 hours fall within a relatively narrow range of .7% to 1% as measured at 30°C. Here again, we notice the slight difference between the carmelized glass cloth (Figure 9) and the standard glass cloth (Figure 8). This difference shows only after conditioning at 96% relative humidity. After the moisture has been driven off, the values all return to approximately the same values as those conditioned under A, C, and D.

★ ★ ★

An examination of the data would indicate two types of drying. One, the removal of moisture from the surface of the glass fiber. This is removed quickly as indicated by the rapid drop in power factor at 80 and 100°C. The second appears to be the somewhat slower drying of the filler and the gum at 145 C. The latter resulting in further reduction in the power factor as finally measured at 30°C. The amount of moisture is small. SE-100 on glass tape will pick up only about .1% moisture after 96 hours at 96% relative humidity, and since it can be driven off quickly, it does not cause any particular difficulty in application. Under normal conditions, i.e. 50% relative humidity, the effect of moisture does not appear to be of any important significance. However, in a completely sealed cable construction predrying after taping might be considered.

★ ★ ★

Additional data on completely heat cleaned glass is needed to complete this picture. We also need to develop ways to obtain better wetting of the glass fibers with silicone rubber products by the use of new types of sizings or coupling agents. Such surface treatments, if successful, will result in even better products for the cable industry.

Cure Vs. Electrical Properties

A study was made of the power factor of SE-100 versus the cure temperature. In this case, consideration was taken of the fact that the most important phase of the curing of the silicone rubber tape is in the first zone of the commercial coating tower. This study was carried out to determine what effect, if any, differences in temperatures in this first zone would have on the power factor and dielectric constant. Studies were made on samples cured under varying conditions in this first zone. Curing was carried out at temperatures from 150°C to 225°C in steps of 25°C. Power factor and specific inductive capacity were then measured after conditioning according to A, B, C, and D indicated above and tested at the temperatures described under the specific inductive capacity measurements.

★ ★ ★

An analysis of the data would indicate that there is no significant difference in the results obtained on samples cured at 150, 175, and 200°C. There is apparently a slight difference in the values as shown where the first zone cure temperature was 225°C. Further studies will have to be made to determine the significance of this point. However, to use this temperature in the first zone of the coating tower is asking for trouble because it would be very hard to control the point where the rubber would start to blister excessively. This data would indicate that there is ample freedom in handling of SE-100 to produce a uniform finished product.

★ ★ ★

The proper cure of SE-100 rubber at a given temperature is a function of the molecular weight of the polymer and the concentration of the peroxide catalyst present in the compound. While benzoyl peroxide is the preferred catalyst for SE-100, other peroxides such as bis [2-4 dichloro benzoyl] peroxide, dicumyl peroxide, and others show interesting and significant differences.

★ ★ ★

In order to assure uniformity of the finished product and make certain that the SE-100 delivered to the cloth coater is suitable for use as an electrical grade, a close control is maintained on the molecular weight of the polymer and the amount of catalyst added as

(*Please turn to page* 581)

Fabricated Wire Products

by Fred Edmunds
Bethlehem Pacific Coast Steel Corporation
Los Angeles, California

Products made from wire have many advantages, both from a fabricating and end-use utility.

In this article, the author points to the experience of one company which has made a specialty of finding ways to produce wire products that can be substituted to advantage for products made of other materials or forms of steel.

Fabricated Wire Products

What has a hot steelmaking furnace got to do with that next sandwich you will be having for lunch?

★ ★ ★

The answer lies in several industries, of course. But, throughout the United States, in a growing volume, custom-made products of steel wire are beginning to find use in both industry and home; an increasing number of these items produced by a Southern California concern.

★ ★ ★

In bakeries, old type wood slat handling boxes are being replaced by light-weight, sanitary wire trays. These trays, in many sizes, are with your loaf of bread from the time it leaves the automatic wrapping machine until it is delivered to your favorite store. In food processing plants, too, variations of this tray are used to handle foods like tuna during the many processing and packaging operations.

Fig. 1. Making perfect circles automatically on a ring forming machine. * * * * *

★ ★ ★

In the home, many contemporary-styled furnishings are partly fashioned from wire. So, too, are frames for interior planter boxes, refrigerator and stove oven racks.

★ ★ ★

From the Los Angeles Wire Mill of **Bethlehem Pacific Coast Steel Corporation,** rapidly becoming a major wire producing source in the United States, coils of wire, drawn from steel wire rods made in the company's local steel plant, are

Fig. 2. Welding the rim of a material handling bread tray. The rim is welded before the installation of the wire mesh bottom. * * *

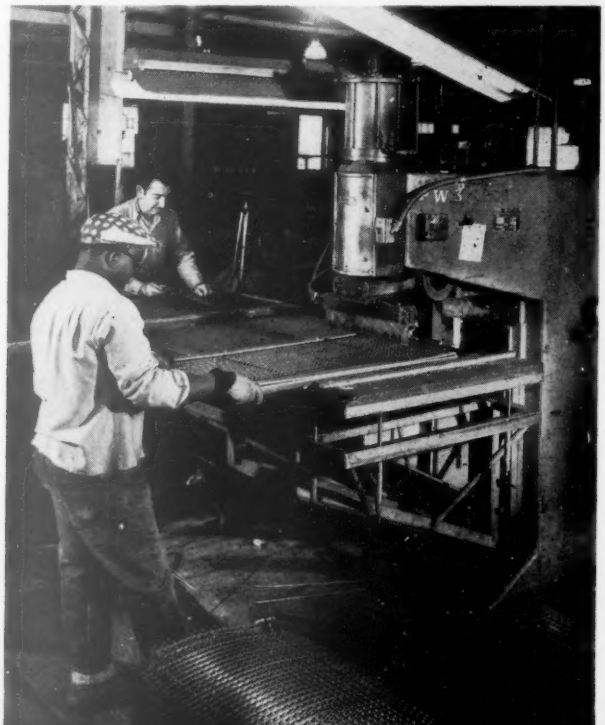


Fig. 3. Special press welders weld wires together after operation in the background lays the lateral wires to form the mesh. * * *

delivered to **Banner Metals, Inc.** of Los Angeles, largest custom-made wire fabricating concern on the west coast.

★ ★ ★

Here, skilled craftsmen turn out an increasing number of products made from wire. And, theirs is a growing list as almost daily new and beneficial uses are pioneered by this company.

★ ★ ★

Important among the reasons for the use of wire by Banner in the manufacture of their many products is the substantial savings in weight per unit compared to previous methods employing other materials. Utilizing wire, for instance, in the fabricating of food display racks for stores not only makes a light-weight, quickly installed unit, but also shows off the product to better advantage and is easily cleaned.

★ ★ ★

Conveyor trays for food processing and baking, with 12 gauge extra smooth clean bright wire mesh bottoms, effect a savings in weight over older, solid trays, reducing the effort needed to move them around. They are also considerably more sanitary, requiring a minimum amount of cleaning.

★ ★ ★

In the schools, an increasing number of posture-correct chairs for the citizens of tomorrow are today fashioned from wire. Fabricated on a special high-speed production line basis, these new chairs are not only easily cleaned, but can readily be moved about and adjusted to the requirements of various classroom activities.

★ ★ ★

Virtually all the wire used by Banner is clean bright low carbon wire in a wide range of gauges, fabricated on special machinery to meet the demands of a custom-made operation. One of these, an automatic ring machine, draws from a continuous coil of wire, automatically cutting to desired lengths and forming a loop or ring in any specified diameter. Because of the many and unusual demands that are made on its production facilities, Banner has to be assured of a steady, dependable, local source of supply for its wire. These varying needs are furnished from Bethlehem's nearby Wire Mill.

★ ★ ★

And, while you are having that sandwich for your lunch, look at the chair on which you're sitting. Perhaps the cushion on your chair, especially if it is one of the new modern designs, has a supporting mesh of 10 gauge wire, fabricated by Banner Metals, a concern specializing in finding new and different uses for wire.

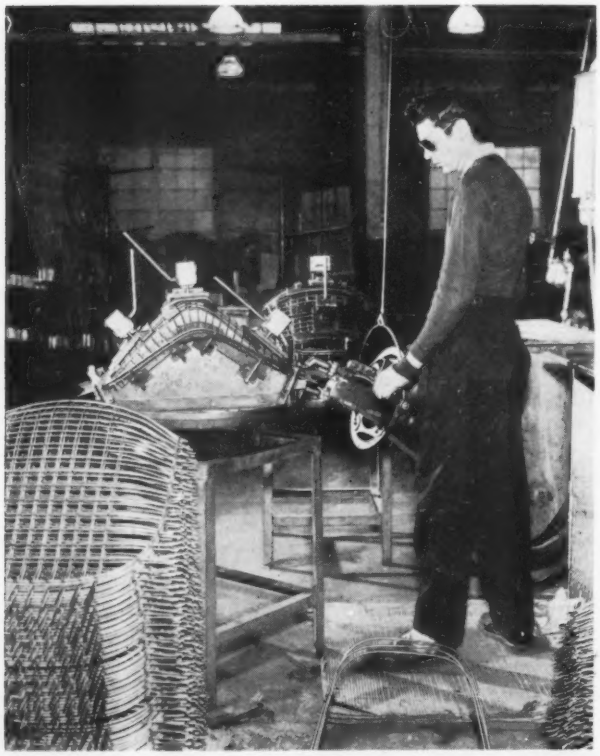


Fig. 4. Chair seats being fashioned over jigs for use in schools, offices, and homes. These seats are sturdy and comfortable. ★ ★ ★ ★

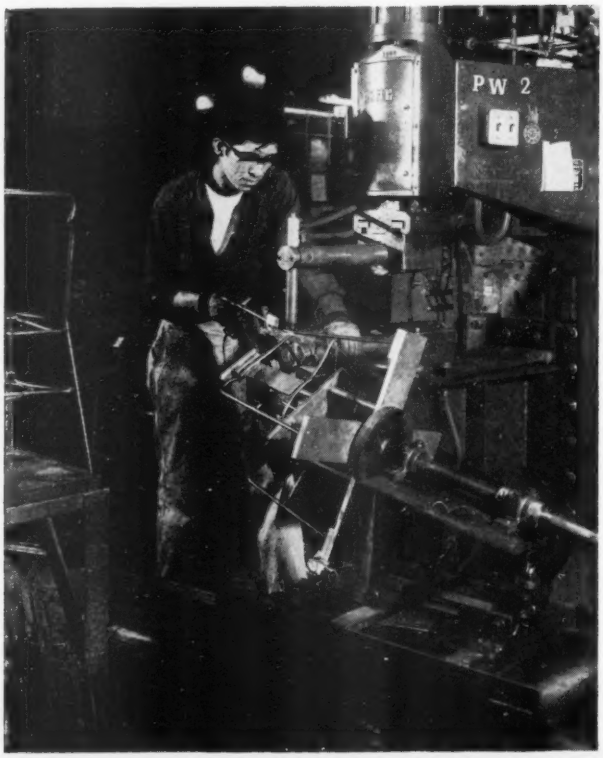


Fig. 5. Chair frames after the wire is formed into shape are welded together in one light weight unit that cannot come unglued. ★ ★ ★

Government Wire Production Information

Report on NBS Research Work

This report summarizes the research and development activities of the **National Bureau of Standards** in the physical sciences during the fiscal year 1956. Brief descriptions are given of representative accomplishments in each area of the Bureau's responsibilities, which include maintenance of basic standards, determination of physical constants and properties of matter, development of methods and instruments of measurement, and the provision of calibration, testing and scientific advisory services.

★ ★ ★

The Annual Report is composed of five sections; (1) a general review or summary, (2) a resume of the Bureau's research and development work in progress or completed during 1956, (3) a review of the testing and calibration program, (4) a discussion of the Bureau's various cooperative activities, and (5) an appendix consisting primarily of statistical and organizational material and a complete list of publications by NBS staff members for the fiscal year.

★ ★ ★

Copies of this 158 page report cost 60 cents each and may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Request the NBS Miscellaneous Publication 220.

★ ★ ★

Foreign remittances must be in U. S. exchange and should include an additional one-fourth the publication price to cover mailing costs.

More Nickel from Cuba

The United States Government has entered into an agreement designed to make available to the nation substantial additional supplies of nickel as well as cobalt, it was announced recently by **Franklin G. Floete,** Administrator of General Services.

★ ★ ★

The agreement was made with Cuban American Nickel Company, a subsidiary of Freeport Sulphur Company. Under the agreement, the Government will accept, at today's market prices, such quantities of nickel and cobalt as may be tendered by the Company during a period ending June 30, 1965 up to a total of 271,000,000 pounds of nickel and 23,835,000 pounds of cobalt. The Government will have the right to require the delivery

MICROMETER PRECISION — MICRO-WELD — TRADE MARK REGISTERED

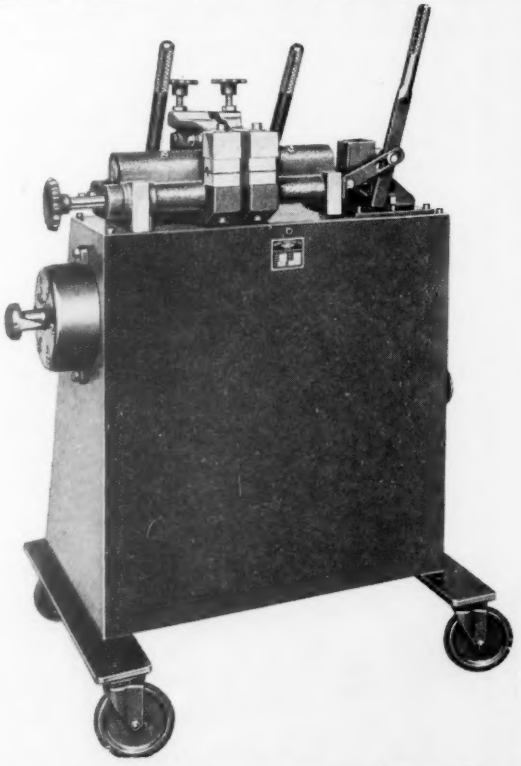
MODEL H-T MICRO-WELD HEAVY BUTT WELDER

A general utility Butt welder for welding Steel low carbon rods and wire ranging in size from 1/8" to 7/8" diameter.

While this unit was not designed for production line work, the wide range in welding capacity makes it suitable for various types of welding requirements.

Equipped with hand-operated toggle type clamping mechanism, providing positive clamping of the stock. Spring actuated movable welding headpiece and close coupling of the transformer provides high efficiency on the welding current.

General construction of this unit is rugged to resist high upsetting forces, and to maintain accurate alignment of the work. Furnished mounted on 4-wheel-truck as illustrated.



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Telephone: STATE 2-7468

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APCO MOSSBERG COMPANY
LAMB STREET, ATTLEBORO, MASSACHUSETTS

of 30% of the annual output of nickel.

★ ★ ★

The production will come from new facilities to be built in Cuba and the United States for Cuban American Nickel Company, control of which is required to be maintained by Freeport Sulphur Company.

★ ★ ★

Since a substantial part of the new facilities will be constructed in Cuba, the project will contribute importantly to the industrial growth of that nation.

★ ★ ★

The Cuban operations will be conducted at Moa Bay on the northeastern coast some 450 miles from Havana. There the orebodies will be mined, the ore will be treated, and concentrates of nickel and cobalt will be produced. The concentrates will be shipped for refining to the Company's new plant to be built in the United States, probably in the Gulf Coast area.

★ ★ ★

The metals will be produced by a new process which was successfully tested by Freeport Sulphur Company in a pilot plant built and operated in cooperation with the United States Government. Officials of the company contemplate the production of 50,000,000 pounds of nickel and 4,400,000 pounds of cobalt per year.

★ ★ ★

The execution of the agreement by the United States Government is in compliance with the policy established by the Office of Defense Mobilization to provide the United States with additional supplies of nickel and is in furtherance of the goal set by that policy.

★ ★ ★

This metal, one of the most critically required of the strategic materials for national defense, is essential for the manufacture of aircraft, guided missiles, electronic equipment and other defense needs. It is also urgently needed for the manufacture of stainless steel and many other essential civilian products.

Fatigue Testing Machine for Spring Wire

A recent constructed machine for fatigue-testing small diameter wire is proving very useful in studies of spring materials at the **National Bureau of Standards.** Developed by **J. A. Bennett** and **H. C. Burnett** of the Bureau's mechanical metallurgy laboratory, the machine stresses the straight wire sample in reversed torsion, simulating the stresses in a coiled spring under fluctuating tension or compression load. Results obtained with straight wire in this way show good correlation with the results of fatigue tests on compression springs coiled from similar wire.

★ ★ ★

Because helical springs are often used in applications where they are subjected to many cycles of fluctuating load, their fatigue properties are of major importance. To provide data in this area, the Army Ordnance Corps has for several years sponsored a study of the fatigue properties of spring materials at the Bureau. However, fatigue tests on compression springs are time consuming, and special care is required in coiling, grinding, and measuring the spring before test. The present machine was designed to determine the torsional fatigue properties of spring wire without need of coiling wire into springs. Set-up time is thus greatly reduced as the ends of the straight-wire specimens need only be bent at right angles.

★ ★ ★

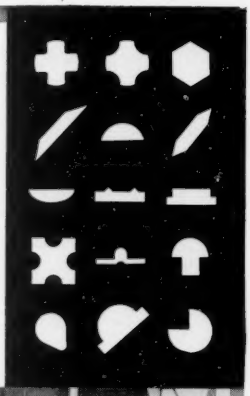
The machine consists essentially of two aligned grip heads that hold the wire specimen while they oscillate individually through an angle of about 120 degrees. The amplitude of deflection in the specimen is set by means of an adjustable coupling that shifts the phase relation between the oscillating grips.

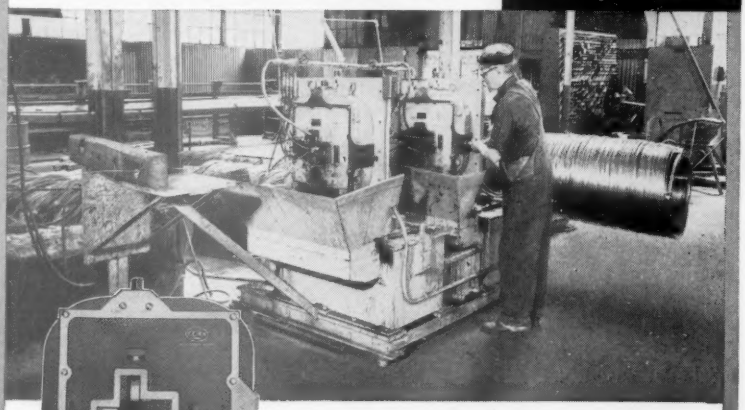
★ ★ ★

The torsional strain for various settings of the adjustable coupling is determined by means of a clip-on dial-and-pointer combination. The dial and pointer are clipped onto the test wire with a predetermined separation (usually 1 inch). Thus, when the two heads rotate relative

Wire Shaping

BETTER, FASTER at LOWER COST





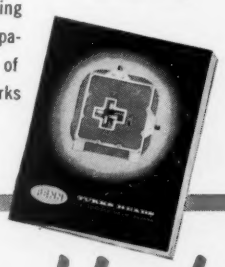
15,000 Pounds of Shaped Wire Per 8-Hour Production Run

The Fenn 4U Universal Type Tandem Turks Head is shown in use at The National Lock Washer Company in Newark, New Jersey. Prior to being formed into lock washers and retaining rings, the wire is drawn through the tandem Turks Head for a two-step reduction which in this case results in a keystone-shaped cross section. The Shaped Wire Division of National Lock Washer, 100% equipped with Fenn Turks Heads, turns out 10,000 to 15,000 pounds of shaped wire every 8-hour production run with only three operators required to maintain this high production rate. Fenn Turks Heads may be used singly, in tandem as illustrated, or in tandem with a rolling mill or draw bench. For complete information on the capabilities, advantages and capacities of the four basic types of Fenn Turks Heads, send today for the new illustrated Turks Head Catalog No. TH56.

FROM ROUND

TO KEYSTONE

IN A SINGLE PASS



FENN Turks Heads

THE FENN MANUFACTURING COMPANY, 601 Fenn Road, Newington, Conn.

NOW the TINIUS OLSEN
ElecTmatic
LO-CAP
UNIVERSAL TESTING MACHINE

This 1000 lb. capacity ElecTmatic LO-CAP is equipped with Type KR Grips for rapid, efficient testing of wire samples in a leading wire mill.

CAPACITIES TO 5000 LBS.
Ideal for testing wire and other specimens, Olsen LO-CAPS are available in standard capacities of 100, 200, 500, 1000, 2000 or 5000 lbs. Higher capacities are also available.

SelecTrange DIAL INDICATION
Load is indicated on the 15-inch color coded dial using the exclusive Olsen Torque Bar Weighing System.

POSITIVE TESTING SPEEDS
. . . infinitely variable crosshead speeds from 0.3 to 12 inches per minute. Speeds are positive under load or no load.

COMPACT
Entire machine occupies less than five square feet of floor space.

CHANGE RANGES DURING TEST
Either of two range capacities—full range and ¼, ⅕ or 1/10 capacity—are instantly available with a flip of the SelecTrange switch.

UNMATCHED FLEXIBILITY
. . . for tension, compression or flexure testing. Stress-strain curves can be made with LO-CAPS equipped with an Olsen electronic recorder, using strain instrumentation—even when "fragile" specimens such as cellophane, fine wire, etc. are tested.

Get the full story.
WRITE TODAY FOR BULLETIN 54.

TINIUS OLSEN
TESTING MACHINE COMPANY
2140 EASTON RD. WILLOW GROVE, PA.

Trademark Reg. U.S. Pat. Off.

Testing and Balancing Machines

to each other, the pointer gives a dial reading of twist per unit length of test specimen.

★ ★ ★

A rubber coupling in series with one of the grip heads provides a small amount of tension on the specimen. When the specimen fails, the rubber coupling retracts the head and thus opens a switch that stops the machine. The number of oscillations at failure is then given by a counter which is driven through a reducing gear assembly attached directly to the motor shaft.

★ ★ ★

Power is provided by a 1/20-horsepower electric motor. The motor causes rotation of a horizontal shaft which is connected at one end to a second horizontal shaft by the adjustable coupling previously mentioned. The free ends of the two horizontal shafts are connected to the shafts of the grip heads by crank mechanisms in such a way as to cause oscillatory motion of the grip heads. Thus, by adjusting the coupling, the relative motion of the two heads can be controlled.

Booklet on Wire Tools

The M. W. Robinson Co., Rockfall, Conn., has issued a booklet entitled "Technical Information on Quality Tools" that they will be pleased to send to wire men upon request.

★ ★ ★

The company manufactures a full line of nippers for cutting wire that are useful in wire mills, wire rope splicing shops, spring making plants, cold heading and screw machine shops, in connection with the use of wire ties in concrete reinforcing work and other places.

★ ★ ★

These nippers come in various sizes and are equipped with removable jaws that may be resharpened. Methods of use, servicing and applications are detailed.

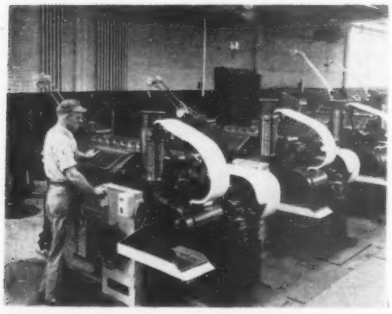
Bethlehem Operating New Fine and Specialty Wire Department

Bethlehem Steel Company has recently completed an expansion

and regrouping of the facilities for making fine wire and shaped wire at their Johnstown, Pa., plant. A new department, known as the Fine and Specialty Wire Department, has been set up for this purpose.

★ ★ ★

Fine wire is being produced in sizes as small as 0.007 in. (40 gage) and shaped wire in sizes from 1/16 in. minimum to ¾ in. maximum (square or equivalent).



Battery of continuous, wet-drawing machines at Bethlehem Steel Company's Johnstown, Pa., plant. Machine in foreground is spooling fine wire as it comes off the block. * * * *

The latter includes squares, flats, ovals, hexagons, octagons, "D"-shapes, and an increasing number of other shapes.

★ ★ ★

Fine wire is furnished with liquor, white-liquor, coppered and other finishes, including redrawn bethanized-electrolytically coated with 99.9 per cent pure zinc. Flat wire is produced in both bright and cold-rolled bethanized finishes. Equipment is also available for supplying fine wire in a wide range of spool sizes.

Zinc Brightener

A new zinc brightener, under the trade name of zinc-kote has been introduced to the plating industry for improved quality barrel plating of small parts at lower cost.

★ ★ ★

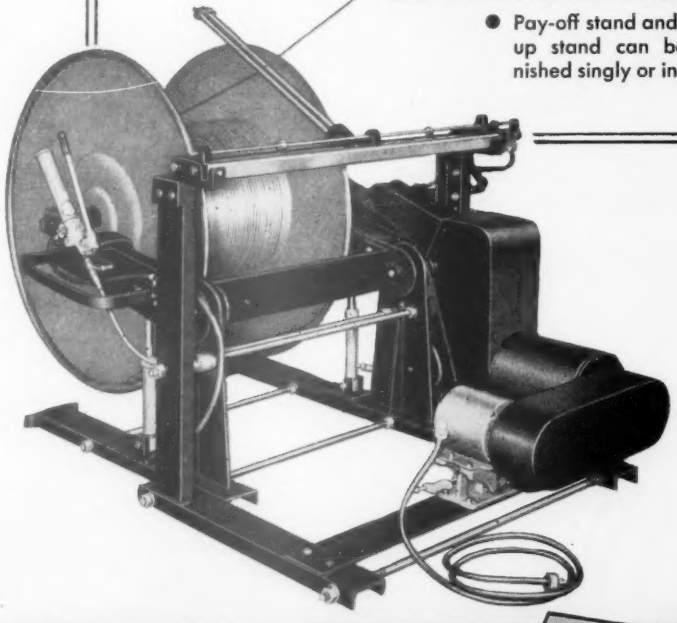
When added to a bath, it produces brilliant zinc deposits on the entire surface of all the parts being plated. Time is saved and production is speeded because bright plating is done directly from the bath to eliminate subsequent bright dipping.

NEW WARDWELLIAN®

PAY-OFF STAND and WINDUP STAND

For Delivering Wire and Cable to Various Types of Production Machines and Winding Product on Reels

- Pay-off stand and windup stand will accommodate reels from 30" to 48" in diameter. Maximum weight of full reel 5000 pounds. Adjustable traverse up to 32" maximum.
- Stands to accommodate reels of greater diameter can be furnished upon request at additional cost.
- Reels raised and lowered hydraulically on both pay-off stand and windup stand.
- Pay-off stand equipped with adjustable friction-control for desired tension of delivery.
- Windup stand equipped with adjustable traverse mechanism.
- Windup stand operated by individual motor through fluid-drive to insure constant rate of draft.
- Pay-off stand and windup stand can be furnished singly or in pairs.



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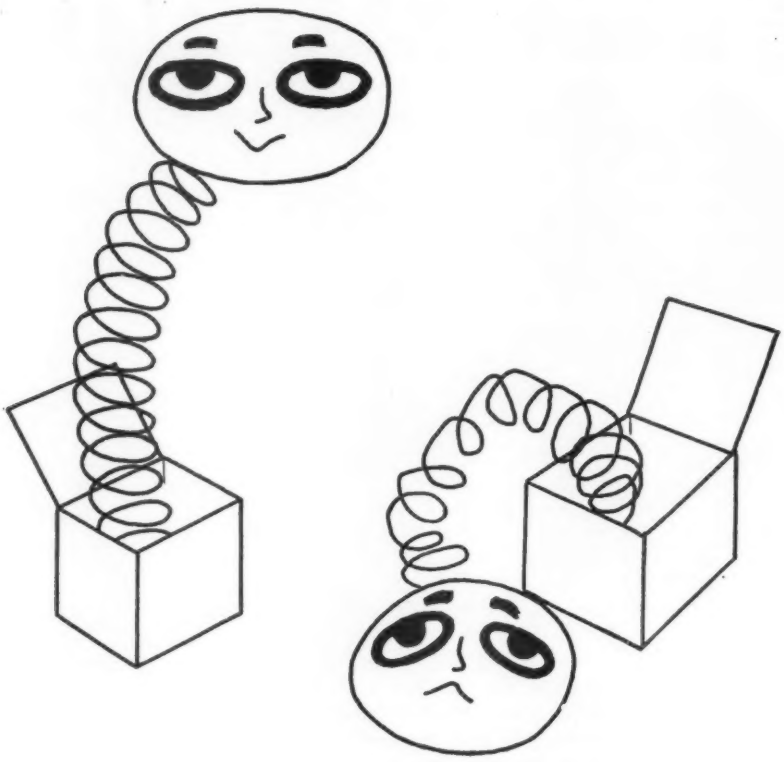


Some Springs Have It...Some Don't

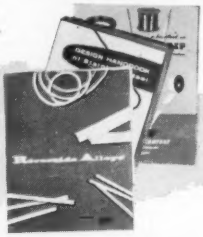
The difference in spring performance is most often due to the wire or strip used... and there's more to a spring material than just the "bounce". How about other requirements, such as corrosion resistance, high temperature properties, fatigue resistance and low temperature toughness.

When your springs need any of these properties your best bet is one of our alloy spring materials.

Riverside-Alloy Metal Division can supply you with spring wire and strip in stainless steels, nickel alloys, phosphor bronze and beryllium copper.

Learn more about our spring materials. Write to Riverside-Alloy Metal Division, H. K. Porter Company, Inc., Riverside, N. J.

Send today for our free handbooks



ALLOY METAL WIRE
Prospect Park, Pa.

RIVERSIDE METAL
Riverside, N.J.

PRENTISS WIRE MILLS
Holyoke, Mass.

HKP RIVERSIDE-ALLOY METAL DIVISION
H. K. PORTER COMPANY, INC.

Zinc-Kote is marketed by the **Smoothex Corp.**, 10705 Briggs Road, Cleveland 11, Ohio.

Wire Cloth Firm Builds New Plant

The new wire screen plant of **Heilig Brothers' Company,** York, Pa., embodies the latest and most efficient equipment layout. Production flows in an almost straight line through successive operations of wire drawing, drum and bobbin winding, weaving, plating, painting, inspection, packaging, storage and shipment. Raw material is delivered at one end and rolls of packaged screening come out at the opposite end to be loaded on freight cars or trucks.

★ ★ ★

The new building is 900 ft. long by 200 ft. wide. Its output averages 250,000 square feet of wire screening per 24-hour day. The plant works three shifts in continuous 'round-the-clock production, six days a week. Jobs are provided for 200 employees.

★ ★ ★

The raw material consists of 7/32-in. steel, ⅜-in. aluminum and 3/16-in. bronze rods. The steel and bronze rods are drawn to fine wires of 0.011-in. diameter and aluminum rod is drawn to 0.013-in. diameter. Normal operation for aluminum wire drawing is 5,000 feet per minute (top about 5,500 fpm), and fourteen dies are utilized to bring the wire to final diameter. Continuous filtration of the drawing lubricant, a new development for the wire screen industry, keeps the dies clean and to accurate gauge at all times. The lubricant is pumped overhead to the bank of drawing units and returned after drawing through a sunken channel in the concrete floor to a filtration tank.

★ ★ ★

Steel wire is annealed in a molten salt bath at 1,300°F after the second drawing to provide the ductility essential to further drawing. After annealing, the wire is cleaned and copperplated to protect the life of the dies and assure more effective galvanizing.

ABSTRACTS

These abstracts are published through the courtesy and with the permission of the Industrial Diamond Information Bureau, 34 Holborn Viaduct, London, E.C.1, England. Inquiries regarding them should be directed to the Bureau.

SIXTY MILES OF WIRE DRAWN FROM ONE POUND OF COPPER
Gen Electr Co, Schenectady. Wire and Wire Prod 1956 Vol 31 (11) p 1348 (Nov)
Wire mill in Co's Medium Induction Motor Dept uses about 6,000 industrial diamonds yearly, ranging up to 1½ ct each, for wire drawing. Tungsten carbide dies used for wire sizes down to 1/16 in. dia. Drawing speeds reach over 5,000 ft/min.

COLLOIDAL GRAPHITE DOES EXCELLENT JOB AS WIRE DRAWING LUBRICANT
Anon. Iron & Steel Eng 1956 Vol 33 (11) pp 140, 143, 145 (Nov)
Various applications outlined. Extremely fine tungsten and molybdenum wire can only successfully be drawn in production when coated with water dispersion of colloidal graphite and heated to leave dry lubricating film on wire surface. Colloidal graphite is one of few substances that will adhere to wire at red heat; 'graphoid' film, formed by graphited wire being drawn through diamond die, permits continuous low-load drawing, and greatly lengthens die life. Many other lubricants tested for this application, but none found practical. 4 illustr.

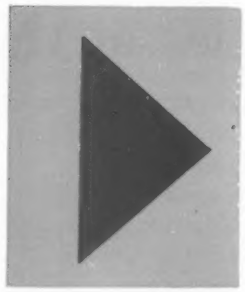
ULTRATHIN COPPER
Am Silver Co, Flushing, NY. Steel 1956 Vol 139 (25) p 85 (Dec 17)
Copper tape made in thicknesses down to 0.00015 in. for use in US Air Force wafer-type coils, replacing bulkier heavier wire. Various applications foreseen.

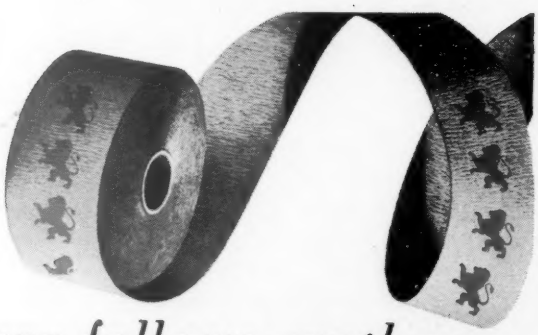
STRAIN MEASUREMENTS IN NARROW BORES
H. Buhler, W. Schreiber. Philips Serving Sci & Ind Vol 3 (5) pp 85-87; PERA Bull 1957 Vol 10 (1) p 12 (No 41109) (Jan)
Description of strain gauge equipment and devices suitable for making strain measurements in deep and narrow bores.

DETERMINATION OF FATIGUE STRENGTH AT SYMMETRICAL ALTERNATE TENSION STRAIN OF SMALL DIAMETER AND HIGH STRENGTH WIRES
K. Elias, F. Kotrbaty, F. Pokorny. Hutnicke Listy 1956 Vol 11 (12) pp 728-732 (Dec) (In Czech; summaries in Russian, German, English, French)
11 illustr, 8 ref, 3 tables.

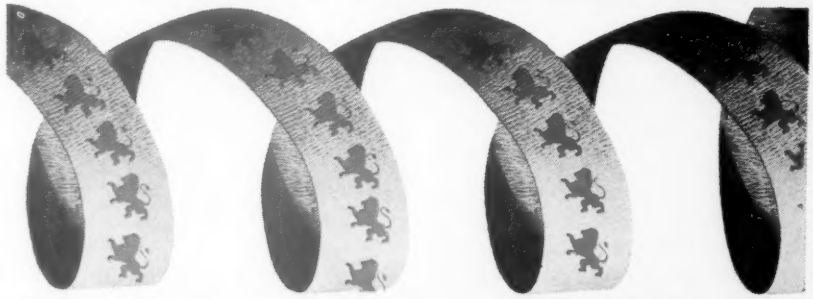
ELASTIC AFTER-EFFECT [IN ALUMINIUM AND NICKEL WIRES]
T. Huzimura, T. Sutoki. Tohoku Univ Res Inst Sci Rep 1956 Vol 8A (2) pp 79-86; Inst Met Journ: Metall Abstr 1956 Vol 24 (3) col 129 (Nov)

(*Please turn to page* 580)





one good turn follows another . . .



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Available in widths and diameters to fit all wrapping equipment. Tightly wound to provide the maximum yardage in as few rolls as necessary—reducing the "change-over time" so definitely affecting production.

Your design, or one created by our art department at no charge, will be printed in as many as four colors. The advantages of colorfully, attractive, sales promoting packaging more than justifies the slight additional costs.

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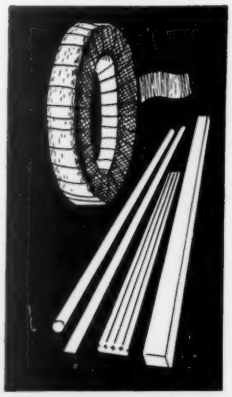

EST. 1896

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PLANTS: CHICAGO, ILL. • NEWPORT NEWS, VA.

Outstanding Personalities of the Wire Industry

Chemical Products Elects Two Vice Presidents

Following a meeting of the Board of Directors of the **Chemical Products Corp.** on January 17, 1957, the company's president, **William I. McGowan,** announced the election of **Joseph S. Hawes** as Vice President in Charge of Lacquer Sales and of **Hugh B. Allison** as Vice President in Charge of Chem-o-sol sales. Both are located at the company's main office at King Philip Rd., E. Providence, R. I.

★ ★ ★

Mr. Hawes was long associated with **New England Lacquer Co.** before it became affiliated with **Chemical Products** in 1947 and was formally merged in 1954. He became a specialist in lacquers for insulated wire and will now direct the entire sales activity of the company in the field of specialized industrial and decorative coatings for insulated wire, fabric, paper, molded plastics and jewelry.

★ ★ ★

Mr. Allison, who joined Chemical Products in 1948, will direct the sales of Chem-o-sol. For almost a decade he has been closely associated with the development of the rapidly growing group of polyvinyl dispersions (plastisols) that the company custom formulates and manufactures under the trade name Chem-o-sol. He is fully qualified to advise on the adaptation of Chem-o-sol to improve processes and products in all types of industry.

Joseph S. Hawes Hugh B. Allison

To Manage Stainless Steel

Crucible Steel Company of America has announced the appointment of **William B. Downes** as Manager-Stainless Steel Sales Division, with headquarters in Pittsburgh. He had been Assistant Division Manager for stainless steel sales for more than two years. In his new capacity, he will maintain overall responsibility for sales of the Company's stainless steel products.

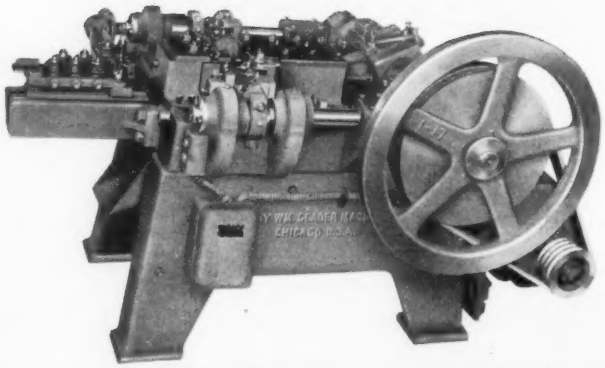
★ ★ ★

Mr. Downes has been with Crucible almost 23 years, joining the Company shortly after graduating from Rutgers University in 1934 with a Bachelor of Science degree in business administration. After serving five years in correspondent capacities in the Company's

GLADER NAIL MACHINE

a NAME and MACHINE
that have stood for
DEPENDABILITY since 1887

our Nail Machine
"KNOW-HOW"
means $$$ for you



Wm. GLADER MACHINE WORKS 210 N. RACINE AVENUE CHICAGO 7, ILLINOIS

EXPORT DEPT. 122 EAST 42ND STREET • NEW YORK 17, N. Y.

New York Office, he was named Manager of welding wire and electrode sales for the stainless division. In 1945 he was appointed Product Manager of bar, wire, and weld rod sales. Appointment in 1948 as Product Manager for stainless sales brought him to the Company's General Sales offices in Pittsburgh.

Receives High Engineering Honor

Harold C. R. Carlson has been elected a Fellow of the American Society of Mechanical Engineers it was announced in March.

★ ★ ★

To be qualified as a nominee to this honor, one must be an engineer with acknowledged engineering attainment, have had 25 years of active practice in the profession of engineering, and have been a member of the society for at least 13 years.

★ ★ ★

Mr. Carlson is a consulting engineer and heads his own firm, **The Carlson Co.** of New York. He is also president of the **Carlco Corp.** of New York, a firm specializing in international research on products, processes and development.

★ ★ ★

His consulting practice covers industrial management, machine design, product development, manufacturing methods, plant layout and he also specializes in work for the spring manufacturing and wire forming industry and holds patents on spring coilers, spring testers, torque testers, grinders and other products.

Harold C. R. Carlson

★ ★ ★

Mr. Carlson is a director of the A.S.M.E. and of the New York Chapter of Professional Engineers, a member of Pi Tau Sigma and is active in several engineering societies.

Shawinigan Resins Appointments

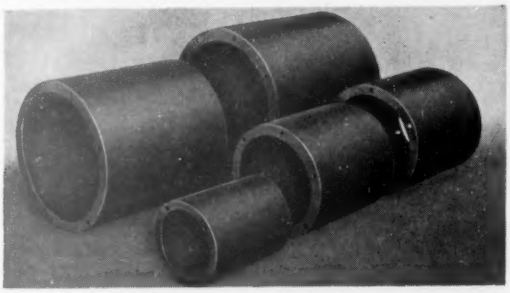
Shawinigan Resins Corp., Springfield 2, Mass., has made known the realignment of various staff functions in the firm's marketing department. The changes raise three functions to departmental status, according to **A. W. Dunning,** director of marketing.

★ ★ ★

These appointments involve **W. K. Wilson,** manager of technical service; **J. A. Cooper,** manager of product development; and **D. H.**

STEEL TRAVERSES FLANGED STEEL DRUMS FOR REELS for WIRE • CABLE • WIRE ROPE

Plain, Painted or Hot-Dip Galvanized Finishes



Left: Assembly of flanges and drums.
Above: Hubbard Steel Traverses (drums).

Made for use with nailed, plywood, metal bound and cast flanges.
Furnished in steel—with plain or flanged ends. Easy to assemble and repair.

HUBBARD MAKES A COMPLETE LINE OF SPOOLS and REELS—ALL CONSTRUCTIONS

We invite your inquiries

HUBBARD SPOOL COMPANY

GARRETT (Tel.: Garrett 840) INDIANA

Fraser, manager of market research, all of whom will report directly to the director of marketing.

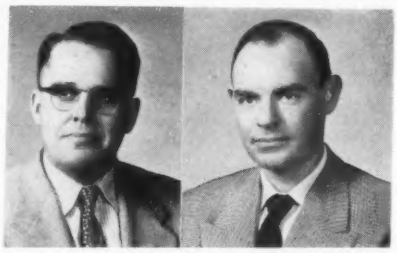
★ ★ ★

At the same time, Mr. Dunning announced that all assistant district sales managers who have been acting managers during the establishment and early development of their territories now will assume the full title and responsibilities of district managers. They are **C. A. Godsell,** New England; **F. H. Hoyt,** New York; **W. M. Young,** Chicago; **L. Roland,** West Coast; and **W. F. Hill,** Atlanta, who will report to **W. H. Bromley,** newly appointed general sales manager. **E. H. Finsilver** has been made assistant general sales manager.

Lee Wilson Personnel Changes

Lee Wilson Engineering Company, Inc. recently announced the following organizational changes: **E. A. Corns,** formerly Director of Research, becomes Administrative Assistant for the Lee Wilson Proprietorship Operations.

C. C. Blackman, former Assistant Chief Engineer, succeeds Mr. Corns as Director of Research for Lee Wilson Engineering Co.



C. C. Blackman R. R. Hill

Former Superintendent of Service and Construction, **R. R. Hill,** was named Assistant Chief Engineer to succeed Mr. Blackman. He will take on the responsibility of Director of Field Service and Construction.

★ ★ ★

J. R. Moran was named Assistant Superintendent of Service and Construction, **E. P. Usiak** from Field Engineer to Combustion Engineer.

G. C. Weaver, former Plant Superintendent, was named to Assistant Production Manager and Plant Superintendent. **W. T. Mittler** was named assistant to Mr. Weaver.

New Plant Manager for Nichols Wire

James M. Morris has been named Plant Manager of the **Nichols Wire & Aluminum Co.,** Davenport, Iowa.

★ ★ ★

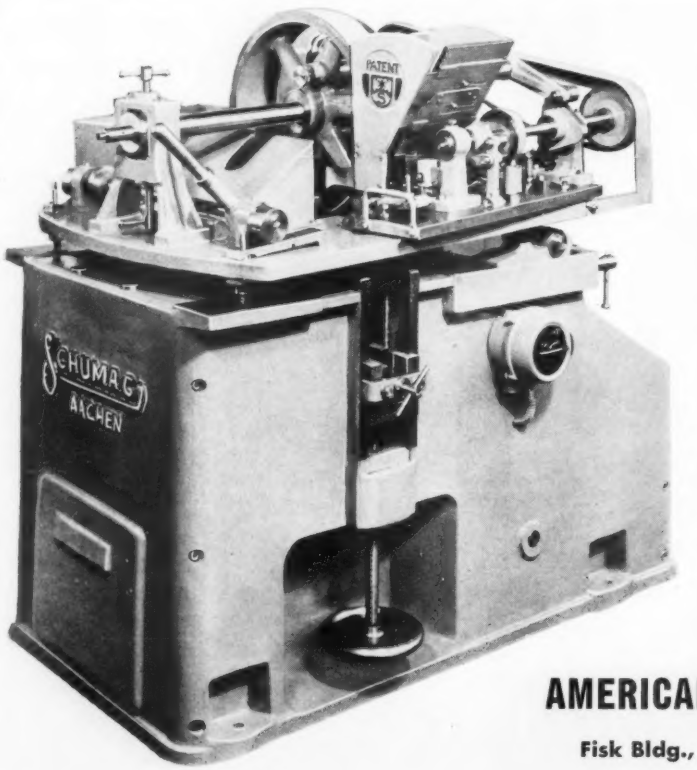
Mr. Morris was graduated from Lehigh University in 1943 and served as a Lieutenant in the Army until 1946.

★ ★ ★

Prior to his association with the Nichols Wire & Aluminum Co. in 1953 he was Production Manager of the Blackhawk Foundry in Davenport.

Armco Executive Appointments at Baltimore

Two executive changes at the Baltimore Works of **Armco Steel Corporation** have been announced by **G. D. Moomaw,** Works Manager.



SCHUMAG AACHEN

Automatic Pointing Machines

For Mass Production

Rates 6,000 - 70,000 pieces/hr.

These machines are designed for completely automatic, high volume pointing of needles and other small cylindrical parts. Length of points adjustable.

Five models:

Shaft lengths from 1½" to 18"
Diameters from .016" to .319"

Exclusive Representatives
for U.S.A., Canada and Mexico

AMERICAN LAUBSCHER CORPORATION

Fisk Bldg., 250 West 57th St., New York 19, N. Y.

Chalmers C. McElvain has been named assistant manager of the plant—the world's largest devoted exclusively to the production of stainless steel—and all operating departments will report to him.

★ ★ ★

Walter H. Roskott has been appointed works industrial engineer. In this position he will supervise all of the plant's industrial engineering activities.

To Head Philadelphia Insulated Wire

The Philadelphia Insulated Wire Co., Philadelphia 6, Pa., announces the election of **Joseph J. Dowling** to the post of President.

★ ★ ★

Mr. Dowling will direct sales of the entire line of PIW wires and cables. The Philadelphia producer has manufactured wire since 1820. The present line includes insulated wire and cable for practically all commercial and industrial applications, including Teflon insulated MIL types.

★ ★ ★

He is an executive engineer with many years experience in the development and manufacture of military and high temperature types of Teflon wire and cable.

★ ★ ★

A major plant expansion is now nearing completion, undertaken to accommodate new wire constructions soon to be put into production by PIW.

To Engage in Consulting Work

Clayton F. Fisher, 73 Cherry St., Spencer, Mass., has resigned as President, General Manager and a member of the Board of Directors of **Sleeper and Hartley, Inc.,** 335 Chandler St., Worcester, Mass., effective January 9, to become a consulting engineer.

★ ★ ★

Mr. Fisher, who is a registered professional engineer in Massachusetts, is widely known as a designer and builder of wire drawing, spring coiling, cable armoring and tube coiling equipment, entered the wire industry in 1916 at the **Spencer Wire Company** at Worcester, which later became the Goddard Works of the **Wickwire Spencer Steel Corp.** He designed wire drawing machines and later became Technical Engineer.

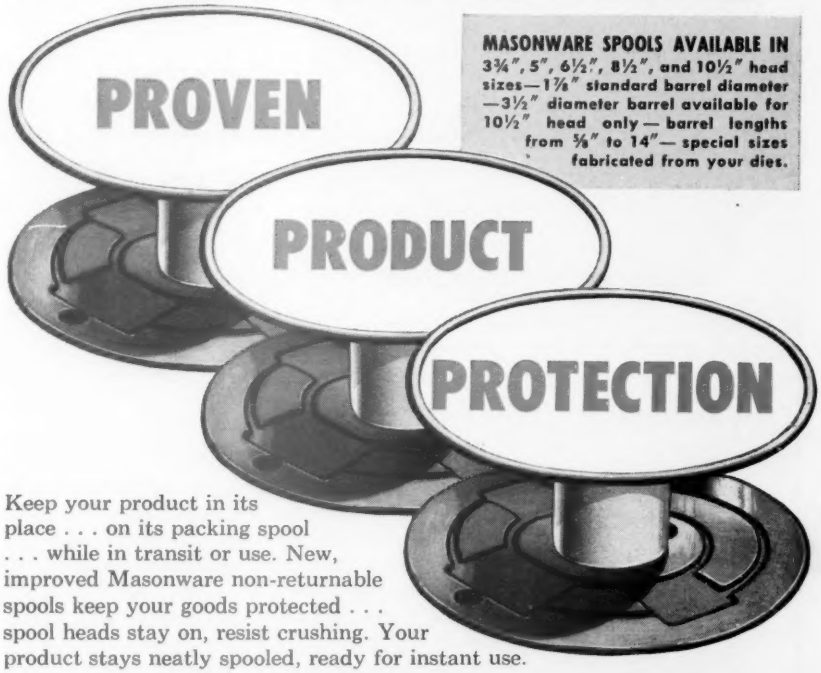
★ ★ ★

In 1920 he was transferred to the Wright Works, where he worked directly under the Chief Engineer. In 1922 he was moved by the company to their Spencer plant as Works Master Mechanic and Safety Supervisor. In 1929 he joined the Rice-Barton Corp. as a designing engineer, specializing in fourdrinier, variable speed drums and other equipment, and went with the Norton Company in 1934 as a general designer of abrasive machinery.

★ ★ ★

He became affiliated with Sleeper and Hartley in 1935 as a designer of spring coiling machinery

New, Stronger Masonware Spools Give You



MASONWARE SPOOLS AVAILABLE IN 3¾", 5", 6½", 8½", and 10½" head sizes—1⅞" standard barrel diameter —3½" diameter barrel available for 10½" head only — barrel lengths from ⅜" to 14"— special sizes fabricated from your dies.

Keep your product in its place . . . on its packing spool . . . while in transit or use. New, improved Masonware non-returnable spools keep your goods protected . . . spool heads stay on, resist crushing. Your product stays neatly spooled, ready for instant use.

One of the oldest spool manufacturers in the country, Masonware services well over 200 companies. These companies depend on lightweight Masonware spools for effective packaging of:

INSULATED WIRE	SOLDER WIRE
THERMO-COUPLE WIRE	WEATHER STRIPPING
TV LEAD-IN WIRE	PLASTIC TUBING
AUTOMOTIVE CABLE	

Tell us about your spool requirements NOW! We'll prove Masonware Spools keep costs down—sales up! Let us solve your spool problem! Write, wire or call:

MASONWARE COMPANY

1949 Dexter Road, East Providence, R. I. • Phone GEneva 4-2810
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STEEL SHIPPING CONTAINERS *for* WIRE PAK*

FEATURING:

- **TOP AND BOTTOM SUPPORT FOR INNER CORE**
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- **SALVAGE VALUE FOR WIRE PAK PAILS**
- **APPROVED STANDARD SPECIFICATIONS**

HUBBARD also makes all types and constructions of spools and reels, offering one dependable source for any type of wood, metal, paper or fibre reel or spool desired.

We invite your inquiries.

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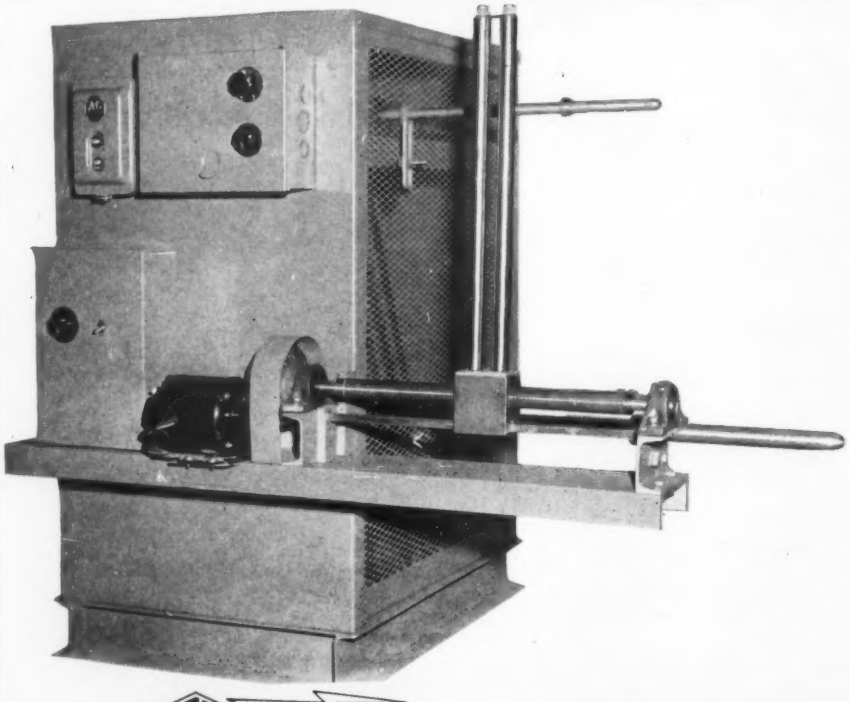
"THE BIGGEST NAME IN SPOOLS AND REELS"



FEDERAL 2 in 1 RE-SPOOLER

Can be used as a Re-spooler or Take-Up. Handles reels up to 30" in diameter.

Speed range 25 to 1, with torque control.

Traverse— Variable width, Variable speed.

OTHER **FEDERAL** PRODUCTS

PAYOFFS • TAKEUPS
CAPSTANS • RE-SPOOLERS
MEASURING MACHINES
PATCHING MOULDS
PAYOFFPAKS
DIELECTRIC TESTERS

THE FEDERAL MANUFACTURING CO. WALLINGFORD, CONN.

WIRE MACHINERY • TESTING EQUIPMENT

and became Chief Draftsman. The following year he was made Chief Engineer.

Firth Sterling Promotes K. E. McKown

Firth Sterling Inc. announces the appointment of **Kenneth E. McKown** as Product Manager, Class I Steel Products and Special Shapes. Firth Sterling Class I Steel Products include high speed toolholder bits, polished drill rod, ground flat stock, and shank steel.

★ ★ ★

Mr. McKown first became associated with Firth Sterling in 1942 in the Carbide Sales Division. At the time of his present appointment, he was Superintendent of Tool Bit, Chromium Carbide and Heavy Metal Production. He will retain his position as Superintendent of the Tool Bit Department.

Auto-Lite Wire and Cable Appointments

D. M. Skirving, Sales Manager, Wire and Cable Division, **The Electric Auto-Lite Co.,** Toledo, has announced four new appointments in the Sales Department.

★ ★ ★

John M. Gerber, who has worked in The Pittsburgh and Chicago offices, will represent the company in the California district, which includes Arizona, Oregon and Washington.

★ ★ ★

Virgil R. Steinmeyer, who has worked at Port Huron and covered Michigan, becomes Manager of the Chicago office which serves Iowa, Minnesota, Wisconsin, Illinois and Northern Indiana.

★ ★ ★

Iloyd N. Bankson, who has worked at Port Huron plant on planning and purchasing, will cover the Michigan, Ohio and Indiana territory.

★ ★ ★

Stewart W. Weidenbach, who has worked on planning and sales at the Port Huron office, will sell in the New York, Pennsylvania, New Jersey and Maryland territory out of Allentown, Pa.

To Head G.E.'s Diamond Section

J. D. Kennedy, manager of component sales for **General Electric's Metallurgical Products Dept.,** Detroit, is new manager of the industrial diamond section, according to an announcement by **K. R. Beardslee,** general manager.

★ ★ ★

He succeeds J. S. Gillespie, who was recently named manager of engineering. Mr. Kennedy joined General Electric's Detroit operation, then known as Carboloy Department, in 1948, becoming a sales engineer in 1949.

Since then he has held several managerial posts, becoming manager of wear part sales in 1950, manager of product projects in 1952, district sales manager in the St. Louis area in 1953—returning to Detroit as manager of component sales in 1955. He holds a B.S. degree in mechanical engineering from the University of Michigan.

Made Staff Assistant

Fred Koelble has been named Staff Assistant for **Pennsalt Chemicals' Corrosion Engineering Products Dept.**

Photo Courtesy of Bedford Wire & Cable Corp.

PLYMKRAFT

CABLE FILLER

for Savings in a Good-Looking Cable

You save time and money in your cabling operation when you use Plymkraft Cable Filler. Its greater fill capacity, greater uniformity, assure you of a better looking cable. Made to fit your particular standard of manufacturing, Plymkraft is available in any type of put up and ready to use. Whether it is treated with wax, jute saturant, or anthracene, Plymkraft is made to meet your moisture requirement in cables. Smooth running Plymkraft is also ideal for highspeed cablers where extra strength is a must. Use Plymkraft Cable Filler, your best bet for clean, efficient cabling.

To keep up to date with cable filler developments, it takes only an inquiry for samples of Plymkraft. To find the quality cable filler best suited for your wire needs, write today to:

PLYMKRAFT DIVISION

PLYMKRAFT CORDAGE COMPANY

PLYMOUTH, MASSACHUSETTS

Carpenter Steel Advances Five Executives

Five men were recently advanced to major executive positions by The **Carpenter Steel Company,** Reading, Pa.

★ ★ ★

John Moxon — vice president, treasurer and secretary—was elected to the new office of executive vice president. **Dr. Carl B. Post**—vice president and technical director—was elected to the board of directors. **Willard E. Roberts**—controller—was elected secretary and treasurer.

★ ★ ★

Kingsley Kunhardt—member of the Board since 1924 — was appointed to the newly established office of chairman, finance committee. **Robert H. Melson**—assistant treasurer—was appointed controller and assistant secretary.

Orin Haskell Joins Lindberg

O. S. Haskell, formerly Manager of Sales, **General Electric Furnace and Oven Division,** Schenectady, has joined the sales organization of **Lindberg Engineering Co.** and **Lindberg Industrial Corp.,** Chicago, Illinois. He will serve as Field Representative for Lindberg's East Coast Sales Office and will operate out of the Greenwich, Conn. office.

G.E. Adds to Research Staff

R. F. Wilson, formerly with General Electric's Welding Department, has joined the company's **Metallurgical Products Dept.,** Detroit, as a specialist in the organization's research and synthesis activities.

★ ★ ★

His new duties will be concerned with research on the cemented carbides. Before joining General Electric two years ago he was engaged in research work at Case Institute of Technology.

Reynolds Metals Appointment

Charles E. Bryan has joined **Reynolds Metals Company,** Louisville, Ky., as Assistant Product Supervisor for electrical conductors.

★ ★ ★

He has served for the past eleven years as chief electrical engineer with a municipal electrical utility which pioneered in the use of all-aluminum conductors for urban distribution.

★ ★ ★

Mr. Bryan was graduated from the University of Louisville in 1939 with a Bachelor of Electrical Engineering Degree. He is the author of several papers on the use of aluminum conductors and other subjects dealing with electrical distribution.

Schwerin Becomes Consultant

Charles H. Schwerin, formerly manager of the Industrial Furnace Division of **The Gas Machinery Co.,** Cleveland, Ohio, resigned from the company on March 1st to engage in consulting work. He will continue to serve The Gas Machinery Co. in this capacity.

(*Please turn to page* 584)

Far greater production in less space with lower cost equipment . . . for all steel and non-ferrous wire.
The fastest, most uniform way to heat treat wire* is often far lowest in cost!
AJAX
HULTGREN
electric SALT BATH furnaces
* Write for case history bulletins on Ajax Electric Salt Baths for
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A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50¢ for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,783,484, AUTOMATIC SCREW MACHINE ATTACHMENT, patented March 5, 1957 by Donald J. Whiteman, Chatham and John J. Koryn, Castleton-on-Hudson, N. Y., assignors to Anti-Corrosive Metal Products Co., Inc., Schodack, N. Y., a corporation of New York.

The inventors provide an attachment in the nature of a screw driver bit, mounted adjacent a slot-cutting saw for rotation about its axis, for engaging the slot in the screw head so that it will turn the screw in order to be cut about the screw head. There are ten claims.

★ ★ ★

No. 2,783,525, WIRE TWISTING AND TINNING MACHINE, patented March 5, 1957 by Herbert D. Scharf, Brooklyn, New York.

This Machine includes a cutting knife for cutting insulation surrounding a stranded wire and applying pressure underneath the cut portion so that the strands are twisted.

★ ★ ★

No. 2,783,782, WIRE BENDING MACHINE, patented March 5, 1957 by John C. Lincoln, Scottsdale, Ariz., and Svend G. Blumensaadt. Beachwood Village, Ohio, assignors to The Universal Wire Spring Company, Bedford, Ohio, a corporation of Ohio.

There are sixteen claims in this patent for bending wire to form coil springs.

★ ★ ★

No. 2,783,816, COILING DIE, patented March 5, 1957 by Tobin Wolf, Bloomfield, N. J., assignor to Westinghouse Electric Corporation, East Pittsburgh Pa., a corporation of Pennsylvania.

A coiling die for a coil winding machine is disclosed of the retractable mandrel type for winding a continuous coil into a coil having legs parallel to the coil axis.

★ ★ ★

No. 2,783,817, CONSTRUCTION ROLL SCREEN UNWINDER AND STRAIGHTENER, patented March 5, 1957 by Rene Leroy, Rockford, Illinois.

This machine is for unwinding from a roll and simultaneously straightening construction wire screen wound in a roll.

★ ★ ★

No. 2,783,911, CORNER FASTENER FOR COLLAPSIBLE WIRE CRATE, patented March 5, 1957 by Harold B. Bussing, Albion, Michigan, assignor to Union Steel Products Company, Albion, Mich., a corporation of Michigan.

In this wire crate, the corner fastener is also constructed of wire.

★ ★ ★

No. 2,784,405, NAILING STRIP, patented March 12, 1957 by Loren F. Working, Jr., Canoga Park, Calif., assignor to Fas'nail, Inc., a corporation of California.

A strip of nails for use in a nailing machine is provided and includes; a nail carrying section extending longitudinally with respect to the strip and having throughout its length, at spaced intervals, areas for the attachment of nail-heads, the areas being readily shearable from the strip; and at least one guide edge along the strip, the edge being formed in a plane intersecting the plane of the nail carrying section.

★ ★ ★

No. 2,785,218, ELECTRIC CABLES WITH LAMINATED ALUMINUM AND LEAD SHEATH, patented March 12, 1957 by Ernst Kirch, Koln-Mulheim, Germany, assignor to Felten & Guilleaume Carlswerke Aktiengesellschaft, Koln-Mulheim, Germany.

About the wire conductor is a double sheathing consisting of two concentric seamless pressed metal layers surrounding in common the whole of the insulated cable core and consisting of an aluminum layer and of a lead layer, which are adherently connected with

The NEWEST!

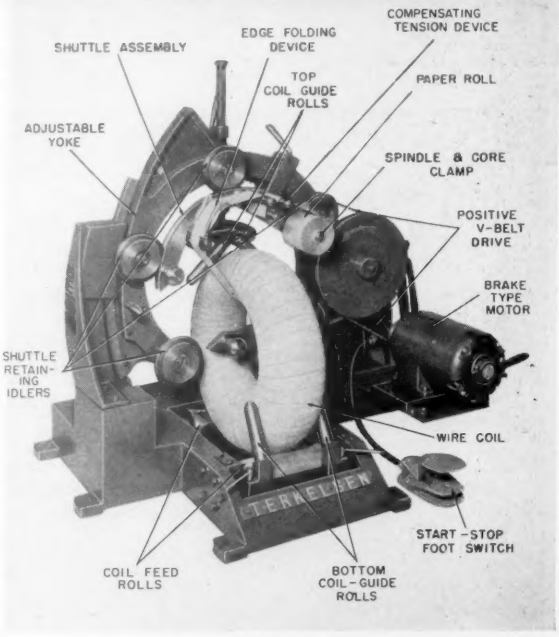
TERKELSEN'S Model 4-57

WRAPPING MACHINE

Wraps wire coils 17" to 30" outside diameter, minimum inside diameter of 10", and with a cross-sectional diameter of up to 10". Larger coil capacities available on order.

FEATURES:

- **POSITIVE V-BELT DRIVE.**
- **HIGH-SPEED PRODUCTION** *unequalled by any machine.*
- **TIGHT & UNIFORM WRAP** *of every coil.*
- **BALL-BEARINGS THROUGHOUT.**



For additional information on the Model 4-57 or any of our other 20 standard spiral wrapping machines (for either coils or straight lengths), write to:

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World's Largest Manufacturer of Spiral Wrapping Machines

Member WAS

one another throughout their surface of separation.

★ ★ ★

No. 2,785,403, WIRE STITCHING MACHINE, patented March 19, 1957 by George H. Harred, Westerly, R. I., assignor to Bostitch, Inc., Stonington, Conn., a corporation of Rhode Island.

The machine is adapted to apply spaced-apart stitches in a seam to a carton blank. There are twenty-two claims.

★ ★ ★

No. 2,785,866, MACHINE FOR WRAPPING CONCRETE CONTAINERS WITH WIRE, patented March 19, 1957 by Kurt Vogt, Veinweil am See, Switzerland, assignor to Bureau BBR, Zurich, Switzerland.

Wire under predetermined tension is wound upon the exterior of a concrete container at a predetermined pitch.

★ ★ ★

No. 2,786,639, WIRE WINDING AND STRIPPING MECHANISM, patented March 26, 1957 by Paul E. Schreiner, Kokomo, Ind., assignor to Continental Steel Corporation, Kokomo, Ind., a corporation of Indiana.

In combination with a wire draw block rotatable about a vertical axis, including a friction drum portion on the exterior of the body of the block for winding wire into convolutions of predetermined diameter and for applying an upward thrust to said convolutions to force the same progressively upwardly in an axial direction off the upper end of said block, the inventor provides apparatus for receiving the convolutions. There are fourteen claims.

Rome Cable Buys J. T. Cope

Rome Cable Corp., Rome, N. Y. completed negotiations for the purchase of plant, equipment and other assets of **T. J. Cope, Inc.,** Collegeville, Pa., as of April 1st. This announcement was made in a joint statement today by **H. T. Dyett,** Chairman of the Board and **A. D. R. Fraser,** President of Rome Cable.

★ ★ ★

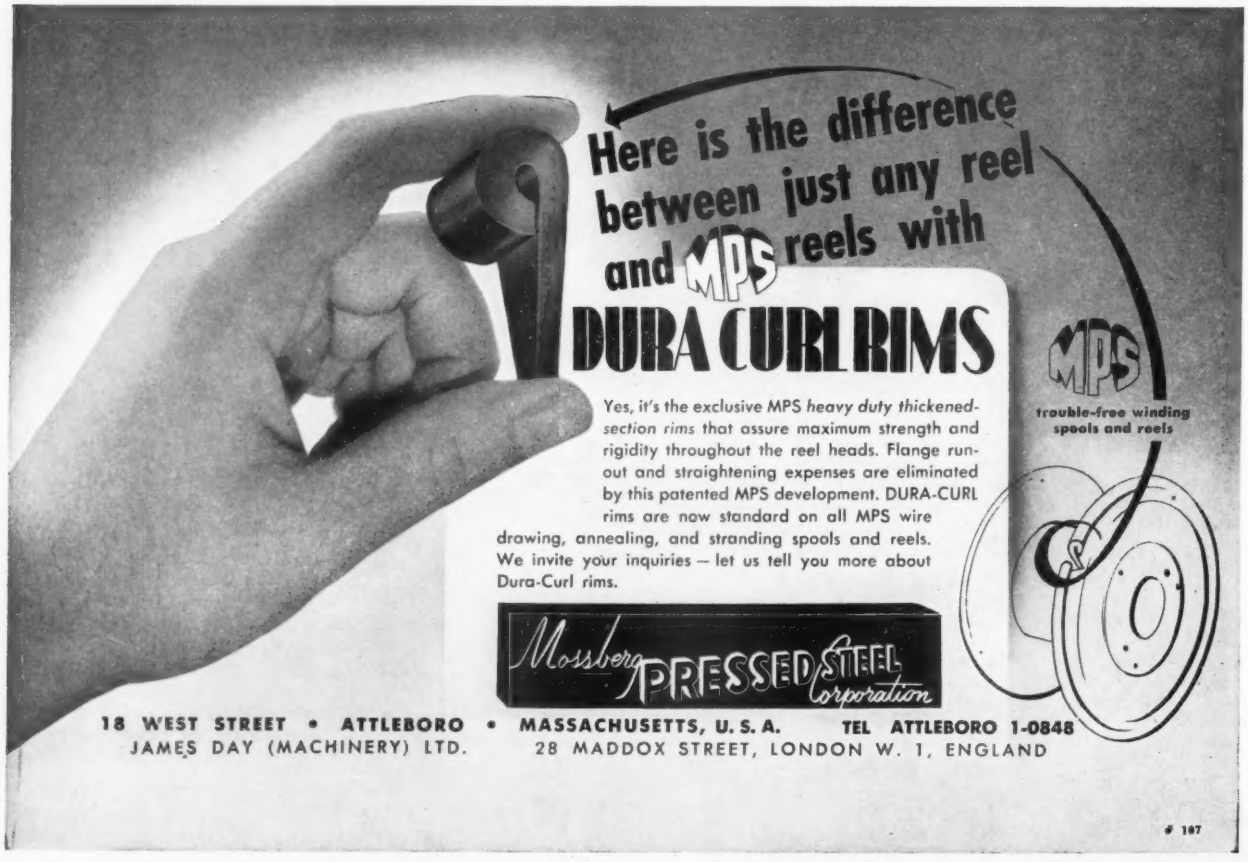
T. J. Cope, Inc. was organized by Mr. Cope in 1885 and has been owned and operated by **Edgar W. Baird, Jr.** from 1934 until his death early this year. The firm has been a leading manufacturer of special products for the electrical industry. In 1948, it pioneered the development of expanded steel cable troughs, a product now widely used by electric utilities and many industries as a wiring system. Other products currently produced include cable pulling devices and certain tools and equipment used for the installation and maintenance of underground electrical transmission and distribution power systems.

To Represent Roebling in Cleveland

Elmer A. Trask has been named Cleveland District Manager, Wire Rope and Aircord Division, for **John A. Roebling's Sons Corp.** The appointment, announced by **Walter A. Huber,** the Division's General Manager, was effective on February 1. He succeeds **Earl A. Frazier,** who now heads wire rope and aircord sales at Roebling's New York office.

★ ★ ★

Mr. Trask, formerly Product Sales Manager at the firm's main office in Trenton, N. J., is well known in industrial circles, having been associated with Roebling for 33 years. His new sales area includes Ohio, sections of Michigan, West Virginia, Pennsylvania and Western New York State.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DURA CURL RIMS
Yes, it's the exclusive MPS heavy duty thickened-section rims that assure maximum strength and rigidity throughout the reel heads. Flange run-out and straightening expenses are eliminated by this patented MPS development. DURA-CURL rims are now standard on all MPS wire drawing, annealing, and stranding spools and reels. We invite your inquiries – let us tell you more about Dura-Curl rims.
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187

AMERICAN IRON AND STEEL INSTITUTE

150 EAST FORTY-SECOND STREET, NEW YORK 17, N. Y.

AIS 10

Total Number of Companies Included 128

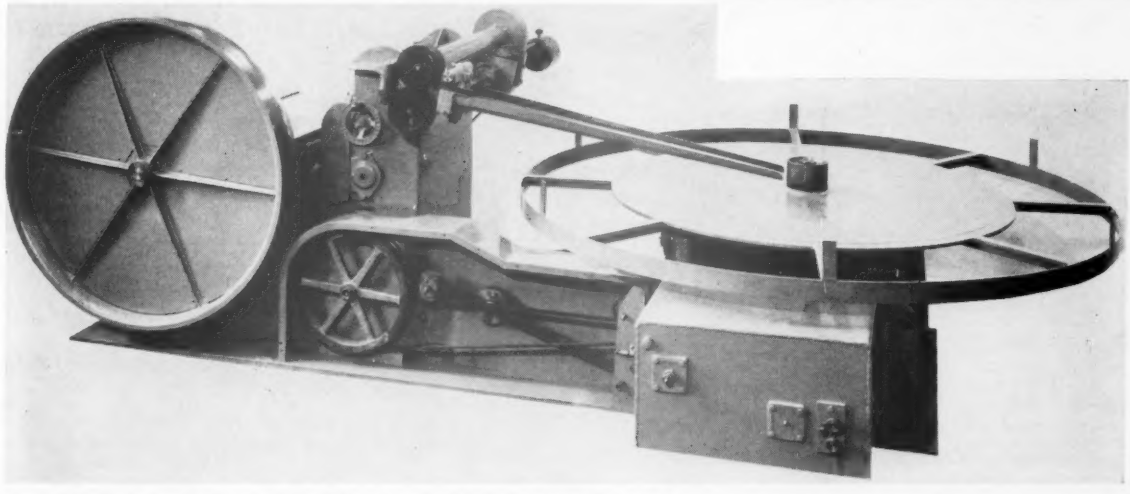
FEBRUARY - 1957
Month

SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING CARBON, ALLOY AND STAINLESS
(Net Tons)

Covering Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or for Resale)

Steel Products	Items	CURRENT MONTH 1957 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1956) Percent of Total Shipments	YEAR TO DATE * 1957 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1956) Percent of Total Shipments
Ingots and Steel Castings	1A	29,339	16,307	1,993	47,639	0.7	1.1	56,272	31,909	4,016	92,197	0.6	1.0
Blooms, slabs, billets, sheet bars	1B	155,550	41,091	2,141	198,782	2.8	3.0	312,046	86,883	5,032	403,961	2.7	3.0
Tube rounds	1C	7,881	731	-	8,612	0.1	-	15,268	1,092	-1	16,359	0.1	-
Skelp	2	19,222	-	-	19,222	0.3	0.2	44,778	-	-	44,778	0.3	0.2
Wire rods	3	83,237	2,314	519	86,070	1.2	1.3	178,420	3,761	977	183,158	1.3	1.3
TOTAL SEMI-FINISHED		295,229	60,443	4,653	360,325	5.1	5.6	606,784	123,645	10,024	740,453	5.0	5.5
TOTAL RAILS AND ACCESSORIES		208,310	38	-	208,348	3.0	2.7	431,764	159	-	431,923	2.9	2.8
Bars—Hot rolled (incl. light shapes)	14	572,228	135,715	5,524	713,467	10.1	10.8	1,215,274	287,833	12,185	1,515,292	10.2	10.8
Bars—Reinforcing	15	234,741	251	-	234,992	3.3	2.3	459,013	329	-	459,342	3.1	2.4
Bars—Cold finished	16	100,064	21,117	5,725	126,906	1.8	2.3	214,204	44,950	12,025	271,179	1.8	2.3
Tool steel	17	1,088	8,094	-	9,182	0.1	0.2	2,294	16,345	-	18,639	0.1	0.1
TOTAL BARS AND TOOL STEEL		908,121	165,177	11,249	1,084,547	15.3	15.6	1,890,785	349,457	24,210	2,264,452	15.2	15.6
TOTAL PIPE AND TUBING		842,549	59,943	2,089	904,581	12.8	11.7	1,810,127	128,675	5,197	1,943,999	13.1	11.6
Wire—Drawn	23	215,072	4,245	2,377	221,694	3.1	3.7	450,589	8,742	5,089	464,420	3.1	3.6
Wire—Nails & staples	24	34,565	-	-	34,565	0.5	0.7	76,389	-	1	76,390	0.5	0.7
Wire—Barbed & twisted	25	5,789	-	-	5,789	0.1	0.1	11,506	-	1	11,507	0.1	0.1
Wire—Woven wire fence	26	22,398	-	-	22,398	0.3	0.4	42,970	-	-	42,970	0.3	0.4
Wire—Bale ties	27	2,861	-	-	2,861	0.1	-	5,785	-	-	5,785	-	-
TOTAL WIRE & WIRE PRODUCTS		280,685	4,245	2,377	287,307	4.1	4.9	587,239	8,742	5,091	601,072	4.0	4.8
Sheets—Hot rolled	31	706,000	22,787	2,132	730,919	10.4	10.7	1,507,473	65,984	4,242	1,577,699	10.6	10.9
Sheets—Cold rolled	32	1,064,819	4,421	13,560	1,082,800	15.3	17.0	2,278,874	8,924	27,175	2,314,973	15.6	17.1
Sheets—Galvanized	33	205,037	11	-	205,048	2.9	3.7	440,933	11	-	440,944	3.0	3.6
Sheets—All other coated	34	18,910	-	-	18,910	0.3	0.3	36,896	-	-	36,896	0.2	0.3
Electrical sheets & strip	36	8,391	49,302	-	57,693	0.8	0.9	19,084	105,102	-	124,186	0.8	1.0
Strip—Hot rolled	37	139,042	3,947	431	143,420	2.0	2.4	286,660	7,274	1,113	295,047	2.0	2.3
Strip—Cold rolled	38	87,673	1,785	18,893	108,351	1.5	2.1	188,178	3,450	39,785	231,413	1.6	2.2
TOTAL SHEETS AND STRIP		2,229,872	82,253	35,016	2,347,141	33.2	37.1	4,758,098	190,745	72,315	5,021,158	33.8	37.4
TOTAL SHIPMENTS (1957)		6,582,506	425,051	59,175	7,066,732	100.0	xxx	13,844,409	907,203	124,517	14,876,129	100.0	xxx
TOTAL — PRIOR YEAR (1956)		6,881,078	528,114	59,201	7,468,393	xxx	100.0	13,851,099	1,084,083	120,347	15,055,529	xxx	100.0

* Revised



SINGLE TABLE PANNING MACHINE NO. 1149

Arranged to Accommodate 80" Diameter Pans.
Can be Built for Larger Pans.
Cut Shows 42" Diameter Capstan.
Wire Guide Spout is Stationary.
Table with Pan Traverses. Pan Table is provided with a Lock so that Table can be released for Hand Panning.
Can be Built as Shown or Opposite Hand.
Not Shown are the Main Variable Drive and also the Guard over the Traverse and Table Drive.

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"American" AIMco INSULATING MACHINERY COMPANY

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FAIRHILL AND HUNTINGDON STREETS

PHILADELPHIA 33 PENNSYLVANIA U.S.A.

COPPER STATISTICS

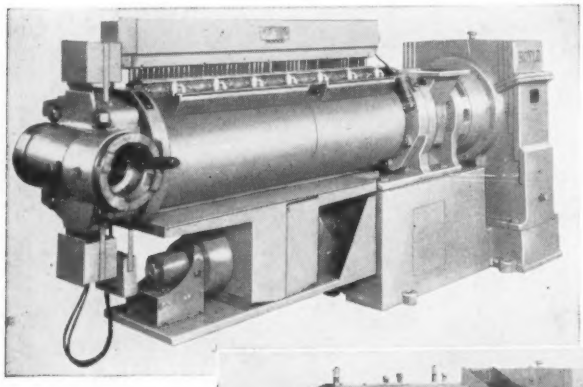
Table I.—Demand for Copper-Base Mill and Foundry Products, 1956-57[a]

[Millions of pounds—metal weight]

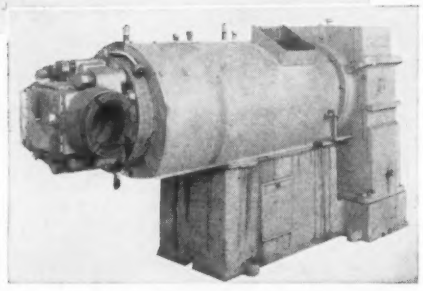
Item	1956					1957			
	Third quarter		Fourth quarter		Year	First quarter		Second quarter	
	Stated requirements	Actual deliveries	Stated requirements	Actual deliveries[p]	Actual deliveries	Stated requirements	Estimated deliveries	Stated requirements	Estimated deliveries
Brass mill products	47	480	42	526	2,313	33	550	39	590
Unalloyed[1]	15	187	11	199	870	11	210	11	220
Rod, bar, and wire	.....	36	.....	36	151	.....	.....	.....	.....
Sheet and strip	.....	48	.....	57	247	.....	.....	.....	.....
Tube and pipe	.....	95	.....	96	432	.....	.....	.....	.....
Alloyed[1]	32	293	31	327	1,443	22	340	28	370
Rod, bar, and wire	.....	131	.....	140	632	.....	.....	.....	.....
Sheet and strip[2]	.....	116	.....	137	599	.....	.....	.....	.....
Tube and pipe	.....	36	.....	39	164	.....	.....	.....	.....
Wire mill products[1] (copper content)	29	369	32	411	1,650	29	400	28	420
Foundry and powder mill products	20	225	21	231	1,013	14	240	15	235
Foundry products	.....	216	.....	222	975	.....	230	.....	225
Powder mill products	.....	9	.....	9	38	.....	10	.....	10

[a] Stated requirements represent military demand under the Defense Materials System (DMS); deliveries represent effective total demand, both military and non-military, as indicated by current information. [p] Preliminary. [1] Actual deliveries include imports of mill products (not available in detailed brass mill product breakdown); estimated quarterly deliveries exclude imports. [2] Includes military ammunition (from strip) on a cup-and-disc weight basis.

Source: BDSAF-83, BDSAF-84, Office of Defense Mobilization, and Bureau of the Census.



8½" Spirod extruder with side delivery head for jacketing. Up-graded from circulating type shown to the right.



EVER THINK OF UP-GRADING TO SPIROD®?

Yes, it can be—and is being—done. And Royle's traditional approach to extruder development, the retention of features that have stood the test of time, makes it possible. The one-piece cylinder with built-in hopper is replaced by a separate cast steel hopper section, a cast steel cylinder with deep grooves that create fin-like separations for the rod type heating elements and the selective evaporative cooling equipment. Head and stock screw, as usual, are designed for process requirements.

If you are operating an older type Royle extruder you should investigate up-grading to Spirod—the electrically heated extruder with high velocity evaporative cooling—for maximum efficiency in controlled operating temperatures.

Write for Bulletin # 463

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ALUMINUM STATISTICS

PRIMARY ALUMINUM PRODUCTION
IN THE UNITED STATES
(in short tons)

1957	
February	119,064
January	147,030
Total through February	266,094
1956	
February	132,762
All-time record month	
July 1956	151,624
All-time record quarter	
4th 1956	442,597

Cobalt Development Institute

The first General Assembly of the **Cobalt Development Institute** was created on January 16th in Brussels, comprised of the world's leading cobalt producers.

★ ★ ★

It is a scientific and technical organization having as its objectives the improvement of existing cobalt uses and the development of new ones.

★ ★ ★

The Institute is represented in this country by the **Cobalt Information Center** at the **Battelle Memorial Institute,** 505 King St., Columbus 1, Ohio, which is in charge of Dr. F. R. Morral, a long-time member of **The Wire Association.**

★ ★ ★

The Center will welcome inquiries on cobalt uses and applications and is equipped to supply technical data to users or potential users of this valuable metal.

Spring Company Expands on West Coast

Connor Spring Manufacturing Co. is enlarging its San Francisco plant to accommodate an expansion of its engineering facilities and to provide additional storage space for raw materials, according to **Gustav Schwarz,** president of the Western precision spring manufacturing firm. The move, which represents a 25% increase in floor space, marks the fourth expansion in as many years.

★ ★ ★

The company also announced that it has on order several new spring forming machines of the latest design to keep pace with the trend toward greater automation and ever-faster production. The new equipment will be delivered this year for use in the San Francisco plant.

★ ★ ★

Connor Spring Manufacturing Co. also maintains plants in Los Angeles, Cal., and Dallas, Texas.

Have You Read
"STEEL WIRE IN AMERICA"?
by Kenneth B. Lewis
The price is $15.00

NORBIDE Abrasive Grain...
cuts die Refinishing Costs!

If you are still using costly diamond dust for refinishing your wire drawing dies, you'll be amazed at the savings you can make by switching to NORBIDE Abrasive. Wire mills everywhere have found that this abrasive—the hardest manufactured abrasive commercially available—is ideal for ripping and semi-finishing operations.

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Making better products... to make your products better
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Many of our customers order NORBIDE Grain in 100 lb. drums. Many others order and re-order ¼ lb. and ½ lb. cans. No matter what your requirements are we can fill your order promptly from stock.
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NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories
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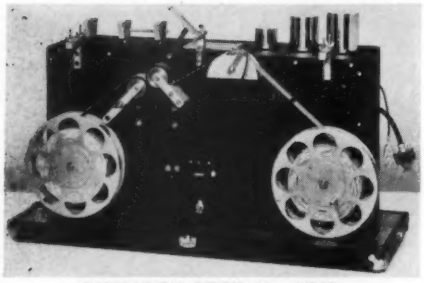
Janco

QUALIFIED ELECTRO-MECHANICAL
PRODUCTS FOR THE AIRCRAFT
AND MISSILE INDUSTRIES



INSULATION TESTER No. 1700

The **JANCO** Abrasive Insulation Tester No. 1700 is specifically manufactured to MIL-T-5438. As a LABORATORY STANDARD, this system provides an abrasion resistance comparison of insulation for aircraft electronic wire and cable in accordance with the following specifications:

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AN-C-161 (1) **AN-C-168**
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Ruggedly designed and portable for field use, the **JANCO** Tester is ideally suited for laboratory, production and receiving inspection applications.

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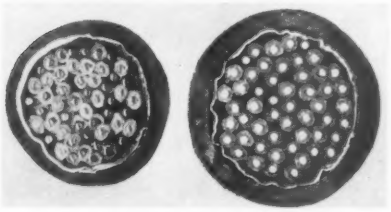
Cellular Polyethylene Aids Telephone Transmission

A new type of electrical insulation based on Bakelite cellular polyethylene is being used to improve transmission of telephone calls and at the same time to reduce the size and weight of communication cables. In its new Ankofoam cable, **The Ansonia Wire & Cable Co.**, Ashton, R. I., has reduced cable diameter by as much as one-third on a 26-pair cable (left side of photo) as compared with its standard polyethylene-insulated cable (right side of photo) without sacrificing its electrical properties. Bakelite cellular polyethylene is an expanded version of the same polyethylene used to insulate radar and high-frequency cable. It is flexible over a wide range of temperature, durable and highly resistant to moisture.



★ ★ ★

Foamed polyethylene has a much lower specific gravity and dielectric constant than unfoamed polyethylene. Lower specific gravity means that a pound of material will cover a greater area at a given thickness. Lower dielectric constant means less line loss and improved transmission. Therefore, without skimping on electrical insulation values, the thickness and weight of insulation around individual wires can be reduced with cellular polyethylene. More wires can be packed into a given cable diameter. Doubling the number of wire pairs within a standard cable diameter is a distinct possibility, according to Ansonia. For example, about 909 pairs of the foam-insulated wire might be squeezed into the space normally occupied by only 404 pairs of wires in the largest current size of conventional plastic-insulated cable. Savings on size are important since this means that a greater number of wires can be strung on the same size poles or pulled through the same size conduits. One of the largest installations of the lightweight Ankofoam cable to date has been made by the Molly's Falls Telephone Co., Marshfield, Vt.

Prutton Appoints Sales Executive

Prutton Corporation, Cleveland, Ohio, manufacturers of Thread Rolling Machines and Planetary Dies, has announced the appointment of **George C. Papp** as Vice-President in charge of sales.

★ ★ ★

Mr. Papp was formerly Sales Engineer and District Manager, Northern Ohio and Western Pa., Marketing Division, Industrial Products Dept. of the **Johnson Wax Company.** He is a native of Cleveland and will maintain offices at the Prutton headquarters in Cleveland.

A REMINDER OF THE WEST COAST MEETING

Please turn to page 510 for full detals of the program of this Regional Meeting at San Francisco on June 13th and 14th—

A FIVE STAR PROGRAM

★ **TECHNICAL SESSION ON PERTINENT SUBJECTS**

★ **PLANT TOUR OF FINE ROD AND WIRE MILL**

★ **COCKTAIL HOUR AND DINNER**

★ **INTERESTING AFTER-DINNER SPEAKER**

★ **A GOOD MOTION PICTURE ON WIRE**

Don't miss this two-day meeting if you can arrange to be there.

V. A. BARBATA, Chairman
RICHARD E. BROWN, Executive Secretary

THE WIRE ASSOCIATION

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Reading Instrument Chart Records

(*Continued from page* 524)

sitive paper can produce a record from a moving light ray.

* * *

Intermittent registration is often performed for galvanometer instruments by means of the well-known chopper bar in conjunction with coloured typewriter ribbon. Every time a magnet attracts the pen lever an impression is made on the paper, finally forming a row of points resembling a line.

Chart Evaluation

The evaluation of a chart record starts with a careful observation of the over-all shape and change of values of the curve. It is then followed by a detailed scrutiny of single values, with special consideration of maximum and minimum points.

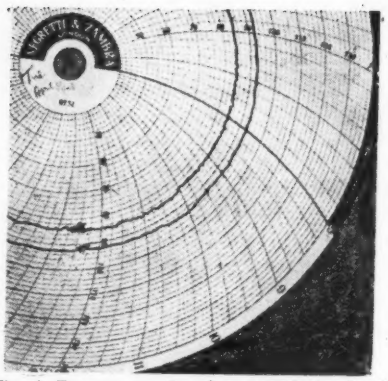


Fig. 4. Two-pen circular chart record. * * *

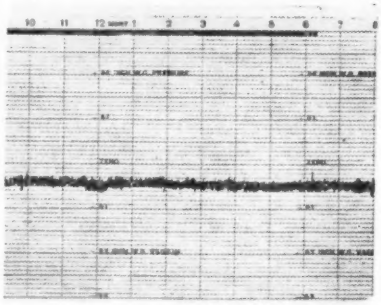
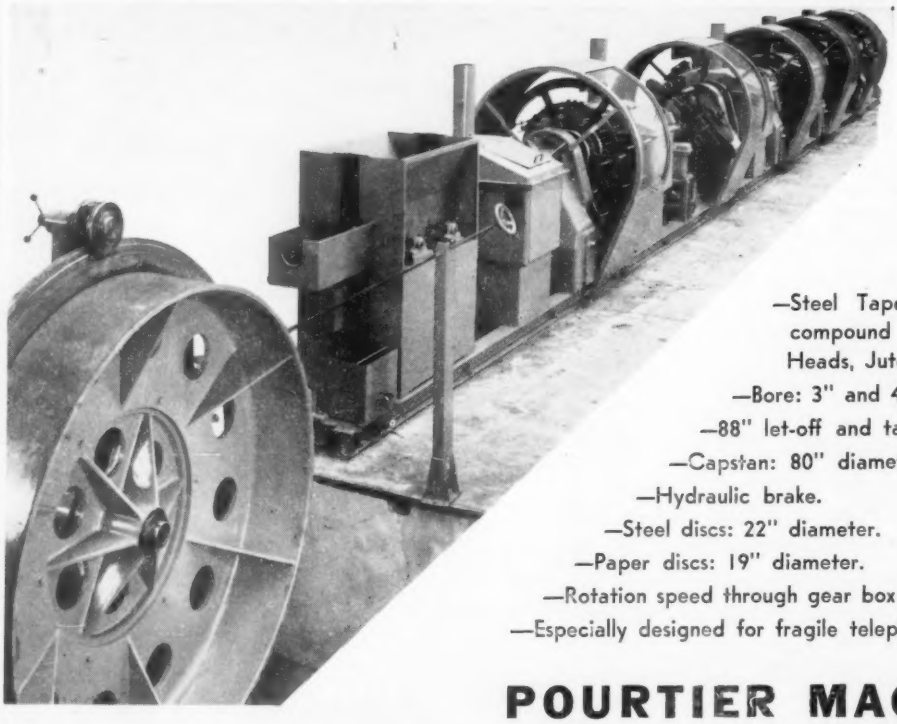


Fig. 5. Drum chart for low gas pressure is blurred. * * * * * * * *

Firgure 4 shows the chart record of a two-pen recording thermometer using a circular chart. In the original, one record is in red ink, the other in blue ink and the pen has drawn perfectly clear lines. It can be seen that temperature fluctuations are scarcely noticeable.

* * *

The drum chart, Figure 5, for low gas pressure or vacuum is less satisfactory for evaluation because the record line is blurred. The pen attached to a linkwork actuated from a float bell, has continuously moved up and down and has made a band rather than a line. The cause was bad servicing of the pen. Nevertheless, as the vertical sections are divided into tenths of inches of water gauge pressure, and subdivided into tenths again, it can be seen that pressure fluctuations were well within 0.22 in. vacuum, which is accurate enough. Readings of values on roll charts is usually an easy matter when the pen works well, and the speed



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—Rotation speed through gear box up to 240 r.p.m.
—Especially designed for fragile telephonic cables.

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of chart movement has been correctly chosen. Modern roll chart recorders have means for convenient exchange of gear wheels in case the speed has to be altered. Where standard roll charts are used, having no calibration in the vertical scale, either a transparent ruler with horizontal values engraved on it can be used for evaluation of results, or marked strips can be pasted on the roll charts.

★ ★ ★

The influence of speed of paper movement should be carefully considered. Obviously, high chart speed produces easier readability by spreading out of record. However, where only extreme values are required and a general check suffices, then a slower chart speed might be adequate.

★ ★ ★

The facility for altering the speed of strip chart recorders has been mentioned. It makes all the difference to have clean and readable charts produced from recorders working at the right speed. In Figure 6 the top shows a single point record whereby the pen oscillates within very narrow and tolerable limits, holding a furnace temperature of 1,220 deg F. with remarkable accuracy. The lower curve is produced from a two-point Cambridge recording - controller and shows two very clear and steady temperature curves, well spaced and readable.

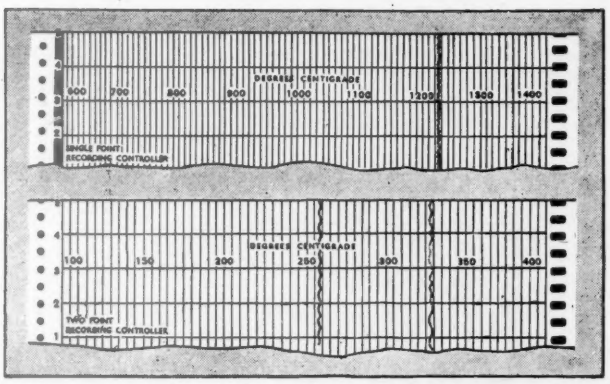

Fig. 6 Showing pen oscillations.

★ ★ ★

Special planimeters are used for integrations of diagrams. Some instrument firms supply a transparent reading scale to be placed over the chart record for evaluation, as shown.

★ ★ ★

In conclusion it can be safely stated that many scientific achievements during the last two or three decades would have been impossible without extensive use of recording instruments.

★ ★ ★

The chart records produce ir-

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Hot-Dip Tank Tinner

Here's a complete tinning system, including: Supply Stand, Flux Pot, Tinning Tank, Water Cooling Tank with Recirculating Pump and Spool Take-Up Unit. An extremely fast unit producing uniformly tinned wire.

- **Can be built to accommodate customer's specifications as to supply and take-up spools.**

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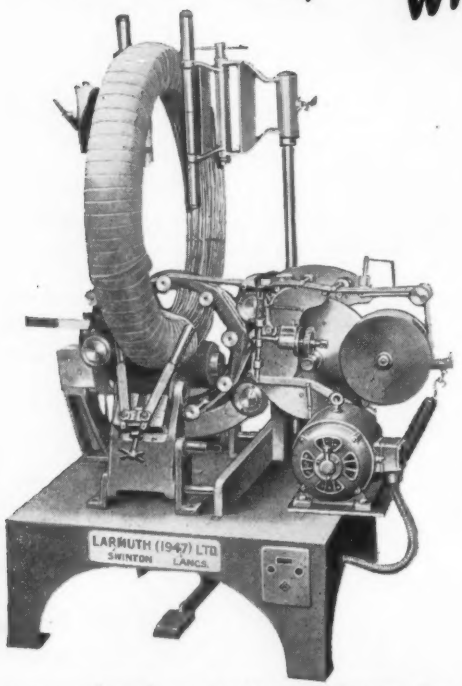

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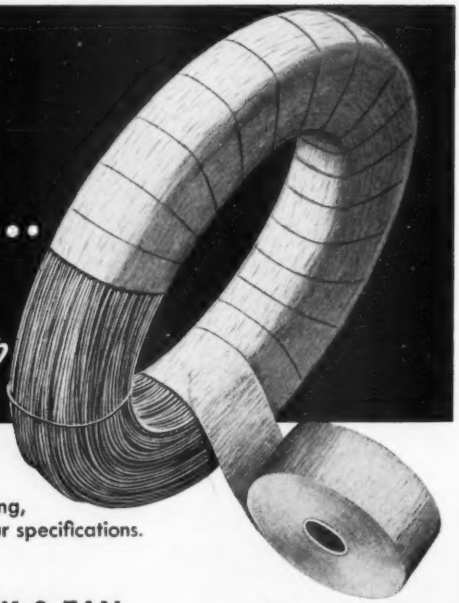

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refutable evidence that the process, whether intermittent (batch) or continuous, has been exactly performed as required from a combination of practical experience and scientific knowledge.

Opens General Offices and Laboratories in Clifton

On March 7, 1957, members of the press toured one of the first application and research laboratories in the country devoted to studies on high density polyethylene, a new development on the plastics horizon.

★ ★ ★

T. T. Miller, President of **W. R. Grace & Co.'s Polymer Chemicals Division** told representatives of the daily and trade press that polyethylene was first discovered by **Imperial Chemical Industries Ltd.** in England in the late 1930's. It was brought into popular use during the early 1940's as wire

W. R. Grace & Co.'s Polymer Chemicals Division, 225 Allwood Road, Clifton, N. J. This building covers 50,000 square feet of space and houses general offices, research and development laboratories, machinery for development of plastics applications, and laboratories for applied physical, chemical and electrical evaluation of plastics.

and communication insulation for the war effort. Since then, research has been underway to make a tougher more versatile material that can withstand higher temperatures.

★ ★ ★

During the last few years several new polyethylene processes have been discovered by **Phillips Petroleum Company** in the United States, **Dr. Karl Ziegler** in Germany, and other companies both here and abroad. Grace has been licensed by Phillips to make this new high density polyethylene.

★ ★ ★

Many useful products made of the new high density polyethylene were demonstrated at the Clif-

ton Laboratories, including toys, coated paper and packaging film, electrical insulation, flashlights and other industrial molded and extruded products.

★ ★ ★

Following the tour of the laboratories, their guests were feted at luncheon aboard the Santa Paula, Grace Line cruise ship, in New York City. **T. T. Miller** served as master of ceremonies, introducing the company's officers and calling upon **General J. E. Hull,** President of the Manufacturing Chemists' Assn.; **William T. Cruse,** executive Vice President of the Society of the Plastic Industry; and **J. Peter Grace,** President of W. R. Grace and Co., to address the gathering.

To Represent G.E. in Texas

James DeKoker, formerly associated with **Bronson & Bratton,** Chicago, cemented carbide die sales agents, has been appointed a Carboloy carbide cutting tool sales representative for **General Electric's Metallurgical Products Dept.** in the Texas area, with headquarters in Dallas.

★ ★ ★

Mechanics of the Slipping Capstan

(*Continued from page* 519)

think of power loss as a percentage of the total input. The expression for percent power loss is

$$\text{Percent loss} = \frac{\text{Power loss}}{\text{Power input}} \times 100$$

$$\text{or Percent loss} = \frac{(C-W)(T_1 - T_2)}{C(T_1 - T_2)} \times 100$$

$$\text{and Percent loss} = \frac{C-W}{C} \times 100$$

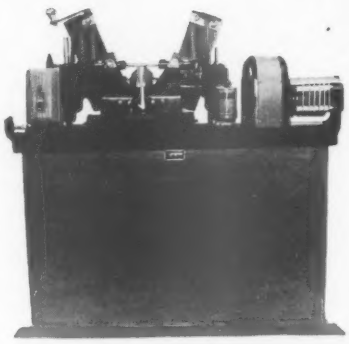
The wire engineer will recognize this expression to be identical to the usual definition of percent slip in a wire drawing machine. Thus, if a capstan has 15% slip, we know that 15% of the power required to drive it is lost in friction.

★ ★ ★

This leads us to the question of the relative advantages and disadvantages of slip in a wire drawing machine. We do not propose to settle this question here, but while the foregoing is still fresh in mind, it might be a good time to enumerate some of the major

PROFITABLE STRIPPING

OF YOUR SCRAP AND REJECTED WIRE & CABLE IS GUARANTEED WHEN YOU HAVE THE RIGHT MACHINE ON THE JOB.



Many of our machines have been in service up to 10 years. Our later MODEL "526" (pictured), with a capacity of 5/16" to 6", is now the accepted leader in the scrap and salvage trade. Strips short or long lengths, or off the reel.

For FAST and CLEAN CUTTING, in most cases actually taking the cable apart. No other machine can match the patented cutting action of the "526".

SAVES ALL RUBBER, PLASTIC, LEAD, COPPER AND ALUMINUM

Several models available for small or special work and plastic tubing.

Detailed information available—ask for it

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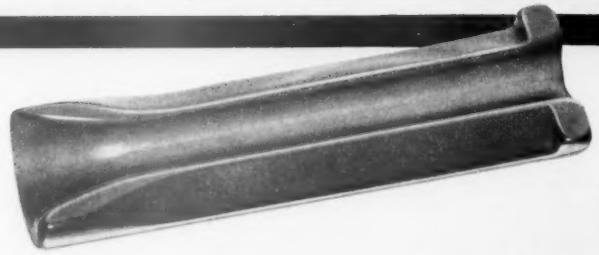

With Beard Whirler Dies and Die Heads you'll save time and money in applying asbestos insulation and in polishing paints and compounds on insulated wire. Order the whirler dies you require from stock. Over 100 sizes immediately available. No costly delays or bottle necks. Dies may be used in wet whirlers or polishing heads. Made of heat-treated polished steel for highest accuracy and minimum wear. Write for spec sheets and detailed data TODAY.

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Faster, Easier
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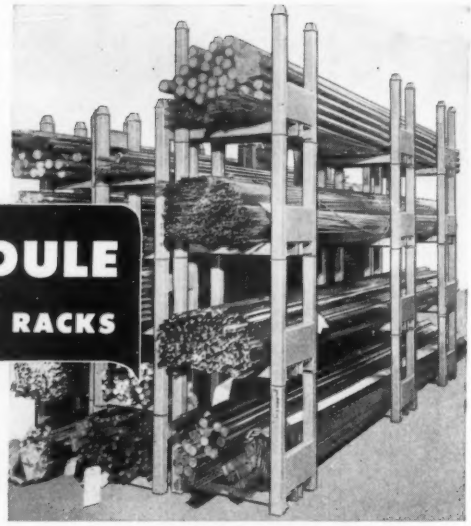

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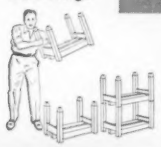

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and fundamental factors on each side of the question.

★ ★ ★

On the favorable side, we can list the following:

1. **Slip provides a simple and practical answer to the problem of synchronizing capstan speeds in a multiple die wire drawing machine where speed relationships are constantly changing with wear in the drawing dies.**
2. **Because of the constant tension ratio, slip provides a degree of automatic tension control which is hardly obtainable by any other means, and does so at minimum initial cost.**
3. **By obviating the need for accurate synchronization under changing speed relationships, slip permits assembly of multiple capstans on a common shaft, thus contributing to simplicity and lower cost equipment.**

★ ★ ★

On the unfavorable side of the ledger, we have:

1. **The abrasive action of the capstan on the wire must necessarily be somewhat deleterious to the surface of the wire, to a degree which is dependent upon the amount of slip.**
2. **Similarly, the wire abrades the capstan and eventually wears it out.**
3. **When there is slip, there is always an associated power loss wth a corresponding increase in the heat to be removed from the coolant.**
4. **Because of the items listed above, it is almost mandatory that a circulating system be provided to flood the machine with a wet lubricant-coolant.**

★ ★ ★

The extent of the evils listed under the first three disadvantages, however, is in direct proportion to the degree of slip. By minimizing the amount of slip, therefore, it is probable that for non-ferrous wires, which do not involve the problems of die lubrication usually associated with steel wires, the advantages of the slipping capstan can be made to outweigh the disadvantages. For the heavier gages of steel which require sull coats, baked lime, and special die lubricants, the nonslip machine is considered mandatory.

★ ★ ★

As a final illustration of the constant tension ratio and amplifying principle of the slipping capstan, an interesting application was made by the student who, in connection with a high school science project, constructed a rather primitive type of public address system.

A schematic representation of the model indicating the mechanical components, as well as their electrical analogues is shown in Figure 5. It may be seen that amplification is based on the use of a slipping capstan as a tension

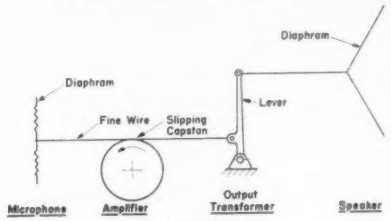

Figure 5

multiplier. Thus, it is theoretically possible that Abraham Lincoln and Mark Antony as well, could have delivered their famous speeches over a public address system constructed of materials and with mechanical skills available during their respective eras if they had known more about sound waves and slipping capstans.

New Resin Fastens Anything to Concrete

A new easy-to-use alloy of micronized steel and epoxy resin called "Steelpatch" is now available from **The Lockrey Company,** Plastics Div., Southampton, N.Y., in handy tubes for fastening conduit, piping, shelving-brackets, wood, insulating and other materials to concrete, without the use of tools. The bond formed is usually stronger than the materials bonded and a single bracket properly applied will support several hundred pounds.

★ ★ ★

The joint is unaffected by heat, moisture and most chemicals and no heating or solvent is required. No careful measuring of components is involved and since the consistency is putty-like, very rough surfaces can be joined. "Steelpatch" can also be used to "glue" broken machine parts together, fill castings, repair cracked engine-blocks, rusted-out mufflers, pipe leaks, etc. For small repairs or attachments it is used alone. To cover large open areas it can be reinforced with fibreglass or other material to hold it in place while curing. Available in 5-ounce tubes at $1.50 and in larger containers.

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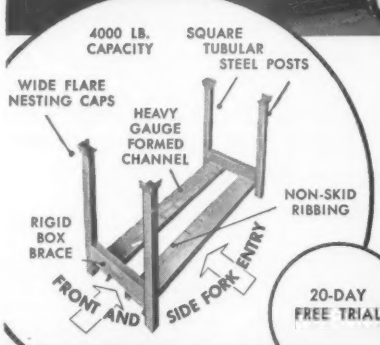

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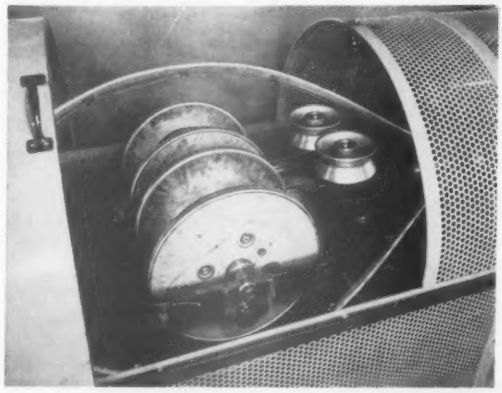
TWO-WIRE DOUBLE TWIST
CONSTANT TENSION TWISTING MACHINE



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Tension control is combined with over run prevention and slow acceleration to permit the use of large reels and long lengths of small diameter wires.

Speeds up to 2280 lays per minute.

Reel sizes up to 24 inches diameter and 9¼ inches overall width or 19 inches diameter and 13½ inches overall width.

These machines are very efficient high speed units.

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Model H 5, AC/DC

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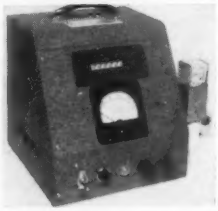

PINHOLE DETECTOR, COUNTER
Model P-1

Indicates and counts pinholes in insulation at speeds up to 600 fpm. For continuous production use on single or multiple conductor wire. Will not harm the finest wire. Comes in several voltage ranges.

A COMPLETE LINE OF DIELECTRIC TESTERS FOR WIRE.
SPECIAL TESTERS WILL BE BUILT TO ORDER.

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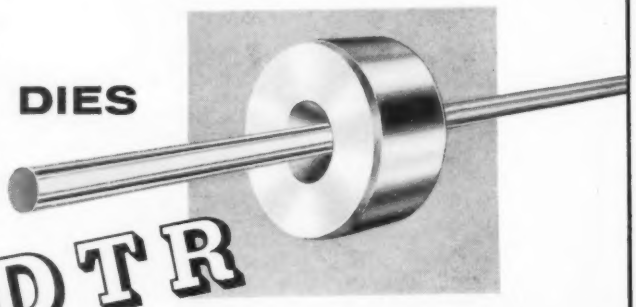
YOUR WIRE DIES WITH DTR



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Wire Coating Quality Aided by Automatic Viscosity Control

(*Continued from page* 521)

Another factor contributing to efficiency, a direct and important advantage ensuing from the use of the viscometer, has been that by varying the control to secure a greater or lesser degree of viscosity, the coating thickness may be made heavier or thinner, with assurance that whatever coating thickness is determined upon, it will remain uniform throughout the run. This is not possible except through automatic and frequent control intervals.

* * *

A representative of the concern visited stated that one particular enamel being used, when applied by the dip method, is so highly sensitive to diluent variations that they have found it impossible to manually dilute it accurately. Too much solvent tends to curd the enamel, which will hold only a certain percentage of the diluent. Through the use of the viscometer this liability to over-dilution and consequent curding has been completely eliminated.

* * *

A final and not the least valuable of the advantages has been a sharp reduction in scrap losses from wire that had to be rejected because it did not have the proper coating thickness or because of thickness variation.

* * *

The Company has found that practically no maintenance has been required.

Conclusion

Once installed the procedure for using a viscometer, simply stated, is to adjust the control point until the optimum viscosity for a particular job is secured. The instrument then takes over and automatically makes the small frequent solvent additions essential to keeping the viscosity just as it is wanted. In practice the checking may take place about once every two minutes or such other interval as may be found to be necessary, depending on the degree of volati-

lity of the solvent used. A clock arrangement is used to control the spacing of the check intervals.

★ ★ ★

While the apparatus may not remove all manual attention at the tower ovens, it is a big step in the direction of automation and contributes greatly toward the control of coating quality, both important factors in the manufacture of electric conductors under today's ever-increasing demand for lower cost and better product characteristics.

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Measurement of Die Wear by Radioactivity

(*Continued from page* 538)

and **A. Pomp** give for drawing with a common salt-lime coating.

★ ★ ★

The values from the third group of tests cannot be used for determining the expansion of the dies since the abrasion was so dissimilar.

Radiographs Indicate Unequal Distribution of Wear

The cited results give information of the mean value of the abrasion. By the evaluation of the radiographic photos efforts should be made to investigate the process of wear in individual cases. On account of the low intensities, however, the photos are hardly suitable.

★ ★ ★

On all the pictures it was evident that the wear was unevenly distributed. For the evaluation of the abrasion, taking the mean is therefore necessary. The film shows in many places a light uniform shading. This justifies the opinion that the cobalt is abraded uniformly, while on the other hand the shaded points are attributable to particles of tungsten carbide.

★ ★ ★

Between the groups of tests 1 (alkali with soap) and 2 (lime with machine oil) a definite difference

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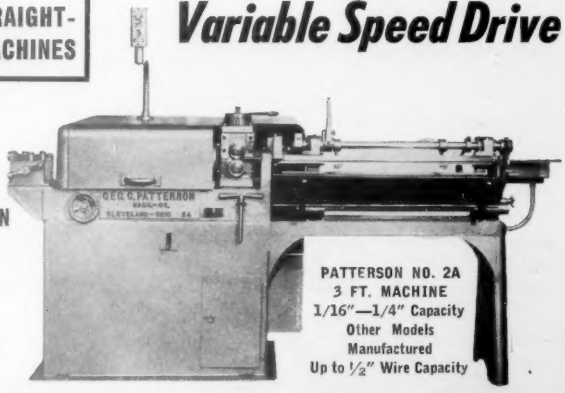

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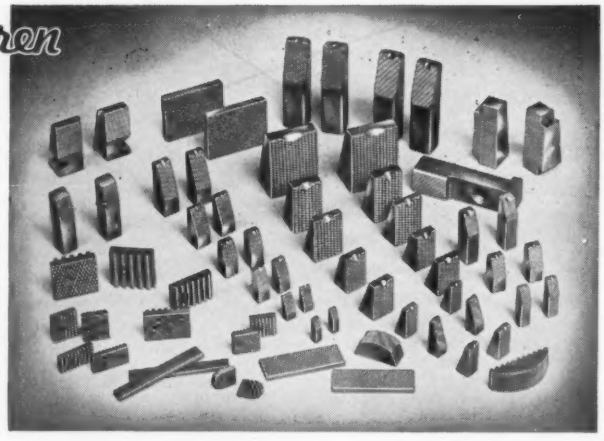

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is determined. In Group 1 the uniform shading is more strongly impressed, and more numerous dark points are found; yet a mathematical evaluation of this evidence is not possible. The photographs of the wire in Group 3 (alkali and soap, with 8 drafts), respecting shadings, lie between those of Groups 1 and 2. According to the counter tube measurements, in this case no clear behavior was to be expected.

* * *

The auto-radiographic photos agree in general with the counter tube measurements and tend to affirm the findings of those measurements respecting the process of abrasion.

The Technique of Wire Nail Making

(*Continued from page* 527)

Machines Must be Properly Placed

Finally the question of space should be touched upon, this being critical in many plants. The machines must be separated sufficiently, in order to permit unhampered passage between them, and the rows of machines must also permit the piling of coils of wire needed for continuous operation, so that empty spools are speedily replaced. The best arrangement of machines is in a row of pairs with the spools toward each other and the piles of wire lying between.

* * *

As nail manufacture involves a great assortment of types, there must also be sufficient space in the polishing room for the deposition of nails to be polished, arranged by kinds and open to inspection, in consideration of the fact that the day's accumulation in many cases, especially of small nails, may be too small to fill a polishing drum economically. With too small storage boxes, there is the danger that samples of equal length, but very slightly different pattern will be placed too close together and, through inadvertence, scrambled together in filling the polishing drums.

Some Considerations on the Use of High Density Polyethylene in the Cable Industry

(*Continued from page* 533)

may be a disadvantage, and it would not appear that they will replace lead or p.v.c. where the conventional material has so far failed to do so.

★ ★ ★

In the field of high frequency communication cables it is unlikely that high density polythenes will replace conventional polythene. In submarine, and high frequency coaxial cables, for example, it shows no advantage and its increased stiffness may well be a disadvantage in handling.

Low Voltage Power Cables

Polythene finds only a limited use as a general purpose insulation. The electrical requirements for this type of application are not very stringent and economics are, therefore, of major importance. High density polythenes could prove advantageous in permitting thinner insulations or giving cables with improved mechanical properties, and it is clear that extensive field trials are required to assess the performance of these materials over a wide range of temperature and weather conditions.

★ ★ ★

In the United Kingdom, house wiring cable insulated with polythene and sheathed with p.v.c. compound finds wide acceptance. This is not the case in some other countries where this type of construction is not approved because it is considered that the polythene presents too great a fire hazard. Flame retardant compounds can be made from high density polythenes as from the conventional materials. Milling chlorinated paraffin wax and antimony tri-oxide into the polythene gives a marked decrease in the rate of burning and prevents dripping of the burning polymer. A compound based on Polythene B has a very high tensile strength but a low elongation at break, and for many applications it is likely that the cost would be prohibitive. There is the possibility, however, that starting from high density polythene, with its improved ten-

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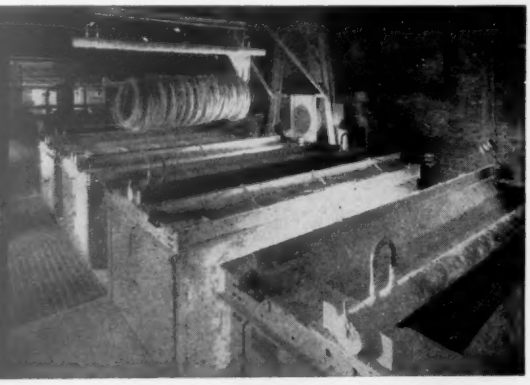

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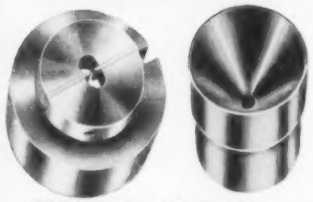

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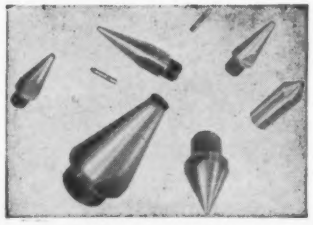

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sile strength, it may be possible to develop new types of flame retardant compound which are satisfactory for low voltage applications.

★ ★ ★

Another possible cable in this category which might find a wide application would have a high density polythene insulation and a neoprene rubber sheath. This latter material has outstanding attractions as a cable sheath because of its toughness, its abrasion resistance, its resistance to fire and to weathering. This would be a high quality cable with a combination of materials not previously attractive because of production difficulties. The high vulcanizing temperatures generally used for neoprene have ruled out the use of conventional polythene, but high density polythenes might well stand up to the processing conditions employed. This combination of polythene insulation and neoprene sheath is also attractive for high frequency coaxial cables.

★ ★ ★

There has always been a demand for industrial power and signalling cables which can operate at high ambient temperatures, and in this field high density polythenes should prove most useful. The aircraft industry might find them acceptable, and in chemical plants, particularly where the atmosphere is of a corrosive nature, they should prove ideal both as the insultant and sheath.

High Voltage Power Cables

Theoretically, polythene is an ideal material for use as the insulation in power transmission. Its low dielectric constant gives a high efficiency, and its high breakdown strength enables the overall size of the cable to be comparatively small, with consequent saving in cost of sheathing and armouring. Because of the difficulties in producing the cable, it has not, however, been possible to make full use of these outstanding properties. No production method has yet been developed which will give a bond between the conductor and

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the polythene insulation such that the possibility of voids and subsequent corona discharge are eliminated, and this limits the working stress to that of air rather than the much higher breakdown stress of polythene. Although a number of 20 KV. cables have been installed, the general development has been severely limited by these difficulties in fabrication and by the risk of the polythene melting under overload conditions.

★ ★ ★

The use of high density polythenes for this type of cable will, if anything, accentuate the production difficulties, since the higher the melting point of the polymer the greater the likelihood of shrinkage voids occurring. These materials do, however, have the very important advantage of improved mechanical robustness at high temperatures. Oil impregnated paper cables are often rated to work at temperatures of up to 80°C. or even slightly higher temperatures, and these new polymers could begin to make the use of polythene more attractive in this field. High density polythenes would permit a 20°C. rise in operating temperature compared with conventional polythene, thus allowing a higher power loading for the cable. The improved creep characteristics would prevent the conductor from wandering under conditions of stress at these higher working temperatures, and should enable the cable to resist deformation under overload conditions.

★ ★ ★

The possibility of operating polythene insulated power cables at higher temperatures by the use of high density polythenes, or irradiated polythene which has similar potentialities, has stimulated interest in this field. Increased attention is being given to the development of techniques, particularly controlled slow cooling of the extrudate, so as to prevent the formation of voids during extrusion, and this should lead to the design of cables to work at higher voltages.

★ ★ ★

If full advantage is to be taken of the increased working tempera-

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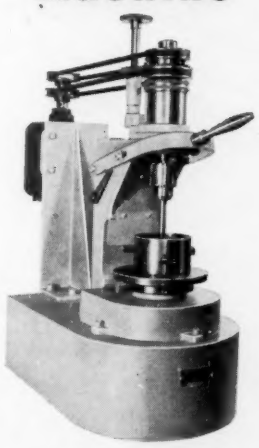

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tures which are possible with high density polythenes, they must be fully protected from the effects of oxidation at these temperatures and improved anti-oxidants over those at present known would appear to be necessary.

* * *

The use of irradiated high density polythene for power cables is also an attractive proposition. The oxidation limitation still exists with this material, but its resistance to stress cracking is markedly increased by a dose of 10-20 megareps, and its mechanical properties at high temperature are improved still further. An improvement in creep characteristics has been measured at room temperature and can be expected at high temperatures, so that once improved anti-oxidant systems have been developed, power cables insulated with irradiated high density polythene might well have an operating temperature above 100°C.

Discussion and Conclusions

The physical properties of high density polythenes make these materials immediately attractive to the cable manufacturer. Their improved mechanical properties, abrasion resistance, and resistance to deformation at high temperatures should enable the cable designer to cut the cost of most cables, either by a reduction in raw material usage or by increasing the rating for a given size of cable. This assumes that the price of high density polythenes will not be significantly higher than conventional polythene once they are in full scale production.

* * *

The data available on the properties of these new polythenes is still very meagre and does not permit a clear assessment of their potentialities to be made. The short term accelerated tests reported here, indicate that in some of the fundamental properties high density polythenes are inferior to the conventional material. The tendency of high density polythenes to be brittle, as shown by their low elongation at break at high rates of strain and the high notch sensitivity at low temperatures, may

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well restrict their use. The embrittlement at high temperatures when under stress, and the oxidation characteristics, are not at present fully understood, and they raise queries as to the service life which can be expected from the new materials.

* * *

In pointing out these apparent defects, it is necessary also to emphasize that they have so far become evident only under the stringent conditions of accelerated tests. Their significance and importance to the cable manufacturer and user has not been established.

* * *

High density polythenes are in the early stages of development and, as such, hold great promise. To establish them alongside conventional polythene as an accepted raw material for the cable industry will require many years of extensive evaluations, both in the laboratory, and in the field under service conditions. Such field trials have always been used by cable makers to establish a new product and their importance cannot be over emphasized. Only by correlating accelerated tests with service trials will rapid developments be possible in the future and the full potentialities of high density polythenes become obvious.

* * *

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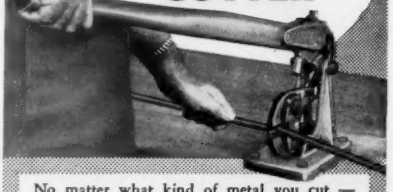

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Abstracts

(*Continued from page* 551)

AN INVESTIGATION OF THE ORIGIN OF THE CONICAL FIBRE STRUCTURE IN TUGSTEN WIRE, BY TESTS ON MODELS

J L. Meijering. Plansee Proc 1955 pp 305-312; Inst Met Journ: Metall Abstr 1957 Vol 24 (5) col 375 (Jan) (Original in German)

Concluded that texture of W wire is determined by physical properties of residue left by added material, eg alkali silicate.

RECRYSTALLIZATION PROBLEMS IN THE PRODUCTION OF SOFT COPPER WIRE

O. Nielsen. Zeits Erzberg etc 1956 Vol 9 (4) pp 151-158: Inst Met Journ: Metall Abstr 1956 Vol 24 (2) col 93 (Oct) (Original in German)

SELECTION OF A LUBRICANT FOR COLD DRAWING. I. COARSE STEEL WIRE

B. W. Sie Siemon (1), W. B. Bauzenberger (11). Iron & Steel Eng 1956 Vol 33 (11) pp 105-108 (Nov)

With discussion. II: Differing merits discussed of straight soap lubricants, emulsions or soap-fat combinations, petroleum oil or its derivatives, and water emulsifiable oils.

INCREASING THE STABILITY OF THE INSTRUMENT AND THE SAFETY OF WORKING IN WIRE DRAWING MACHINES

Yu. N. Volkov. Stal' 1955 (11) pp 1028-1031; abstr Iron & Steel Inst Journ 1956 Vol 184 (4) p 475 (Dec) (Original in Russian)

Correct alignment of wire with respect to die and soap box; self-aligning arrangement described. Photoelectric safety stopping device also dealt with.

SOME CONSIDERATIONS ON BAR AND WIRE DRAWING. Quelques considérations sur l'étirage et le tréfilage Anon. Usine Belge 1956 Vol 33 (1491) pp 6-9 (Sep 15) (In French)

Restored Steel Industry's "Birthplace" Opened on April 16

The Saugus Ironworks Restoration, 300-year-old "birthplace" of America's iron and steel industry, opened for the 1957 tourist season in April.

★ ★ ★

Restoration officials anticipate a record attendance this year. In 1956 almost 22,000 persons, representing 46 states, four U. S. territories and 20 foreign countries visited the shrine to one of America's great industries. Among last year's foreign visitors were tourists from such faraway lands as British Guiana, Russia, Siam

and Zululand in the Province of Natal, Union of South Africa.

★ ★ ★

It is located just east of U. S. Route 1, 10 miles north of Boston. Reproduced in authentic detail are the blast furnace, forge, rolling and slitting mill and the ironworks' wharf and warehouse. There is also the original Ironmaster's House and a museum where old relics unearthed are on display.

★ ★ ★

Built more than 130 years before the American Revolution, the original Saugus Ironworks was a modern plant for its time and was considered the industrial wonder of the day. It operated from about 1646 to 1670 producing much of the iron needed for a fast growing country.

Get the habit of reading regularly
WIRE AND WIRE PRODUCTS
The Wire Man's Magazine

New Developments in Silicone Rubber for Electrical Tapes

(*Continued from page* 542)

well as all other compounding ingredients. In many cases, however, the cloth coater has full control of the finished cloth himself, since 65% of the SE-100 sold is of the uncatalyzed version. Thus, the coater can adjust the catalyst content to obtain the maximum benefit with his particular coating equipment.

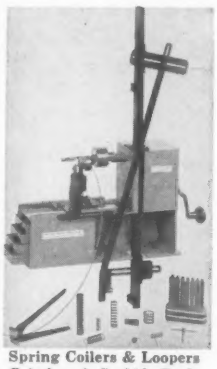
★ ★ ★

Normally, SE-100 is catalyzed with 2% benzoyl peroxide for use in making tapes for cables made according to MIL-C-2194. This gives the optimum cure to obtain the electrical properties required to meet the specification.

★ ★ ★

It is possible to manipulate the cure to obtain a more flexible product desirable for certain applications. For example, the addition of only 1% benzoyl peroxide to the SE-100 provides a more flexible sheath and, because of increase in elongation of the rubber, actually

SPRING MACHINES



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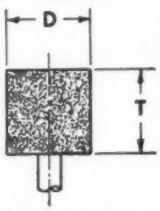

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results in a tougher surface. This version of SE-100 is used primarily for glass sleeving, but may be used for cloth coating applications where additional flexibility may be required.

Semicured Tapes

Another type of silicone rubber product being considered for use as a cable insulating tape is one which can be applied to glass cloth and then given a semicure. This tape can be given a final cure in place to bond it into a homogeneous, void-free insulation. Several silicone rubbers are available to make tapes for this application. The properties of one such typical silicone, 81602, are shown in Figure 10.

Figure 10

Properties of 81602

Color	Red
Solids Content %	100
Specific Gravity	1.5 (typical)
81602 on ECC-128 glass cloth coated one side and cured ten minutes at 150°C plus 4 hours at 250°C gave the following results:	
Build	15 mils
Bond Strength	6-8 lbs. per linear inch
Electric Strength	500 volts per mil
The silicone rubber itself, when molded into slabs 35 mils thickness, oven cured for 1 hour at 150°C and 4 hours at 250°C, showed the following electrical properties. All tests were made at 25°C and 50% relative humidity.	
Volume Resistivity, ohm cm	1.4×10^{15}
Electric Strength, volts/mil	550
Dielectric Constant (60 cps)	3.9
Power Factor (60 cps)	0.007

The use of semicured silicone rubber tapes provides new concepts for new insulating systems for motors, transformers and generators because of three outstanding features:

1. **Corona resistance**
2. **Voltage endurance**
3. **Good thermal conductivity**

★ ★ ★

Silicone rubber tapes are easier to apply than mica tapes and will give comparable performance under most operating conditions. There are a number of types of these semivulcanizable tapes such as dip coated, knife coated on straight weave or bias glass cloth, calendered on straight weave cloth or

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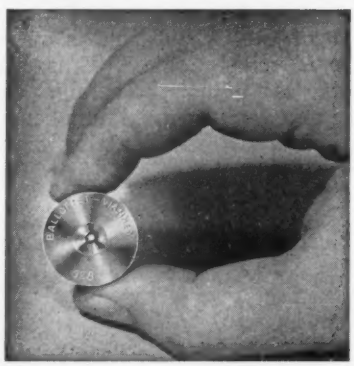

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formed into unsupported rubber tapes. These tapes may be provided in the fully cured state with an adhesive on one side, or may be given only a semicure which will enable them to be further vulcanized to form a void-free, homogeneous insulation.

★ ★ ★

Silicone rubber is now being used in large volume in silicone insulating systems for field coils and armature coils in large motors and generators and in traction motors. As silicone rubber becomes tougher, more and more manufacturers will take advantage of its electrical properties and longer life at operating temperatures. Improvements in electrical properties will be coming along soon and will make it even more feasible to use these products. These new insulating materials are made possible by the development of new gums, filler systems, and catalysts to produce a wide range of properties to fit into a broad field of applications.

★ ★ ★

Silicone rubber of the semivulcanizable type should be considered for use as an insulation for high voltage cable where advantage can be taken of its unique properties. Of particular importance to the cable manufacturer is low power factor and voltage endurance as well as corona resistance. Figure 4, described earlier, shows the voltage endurance of a silicone rubber system made with the semicured tape. While this particular insulating system was not in the form of a cable, the data is shown here to demonstrate this property of a silicone rubber insulation.

★ ★ ★

There are many problems which will have to be solved if semicured rubber tapes are used to manufacture high voltage cable. These tapes should be usable with conventional methods of taping cables. A method of curing the rubber in the finished cable must be devised to develop the best properties of the silicone and to form bonded, homogeneous insulation.

★ ★ ★

The benefits in the use of this type of system are many. For one,

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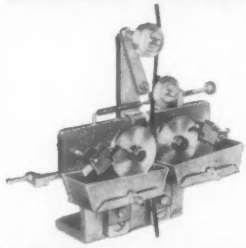

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the cable would be completely sealed with a tough, resilient, moisture resistant product which will withstand the higher temperatures now being encountered in the crowded ducts and in power stations where high ambient temperatures are involved. Slipper compounds and other sealants will not be required.

★ ★ ★

This type of bonded construction is being considered by the Navy for insulation on power cable. It is conceivable that the experience gained here by the cable manufacturers will provide for further expansion of these products into other types of silicone insulated cables above 5 KV rating.

★ ★ ★

By further application development work with these compounds, the cable engineer will be able to take advantage of the many benefits listed below to provide better, more reliable cables for the electrical industry:

1. Ease of application
2. Excellent electrical and chemical properties
3. High thermal conductivity
4. Homogeneous, void-free insulation
5. Longer life at higher operating temperatures and ratings
6. Excellent resistance to vibration and thermal shock
7. Maintenance of electrical properties at elevated temperatures
8. Increased safety factor
9. Corona resistance
10. Standardization of insulation
11. Voltage endurance approaching that of mica insulation

Outstanding Personalities of the Wire Industry

(*Continued from page* 558)

Orban Forms Wire Machinery Division

Sales of "Herborn" wire drawing machines and auxiliary equipment, and "Wafios" wire forming and weaving machines will now be handled by a separate division of **Kurt Orban Company, Inc.,** Jersey City, N. J., it was announced by **Kurt Orban,** president.

★ ★ ★

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Anaconda Appointments

The Anaconda Wire and Cable Co. has announced the appointment of three men as follows: **Robert McIlvane** as assistant manager of cable sales; **P. Howard Farley** as manager of contractor sales; and **Ary Mossiman** as manager of market research.

★ ★ ★

Mr. McIlvane was formerly with **Copperweld Steel Co.**; Mr. Farley has been with **Westinghouse Electric Co.** and the **National Electrical Contractors Association**; and Mr. Mossiman has been with Ebasco Services and comes to Anaconda from **Electrical World.**

C. C. Morin

C. C. "Tat" Morin, President of the **Frost Steel and Wire Company, Ltd.,** Hamilton, Canada, died suddenly on April 14, 1957, at the age of seventy-three.

★ ★ ★

Mr. Morin had been with the Frost Company for 53 years. He forsook the study of law to join the late **H. L. Frost** in the then infant company at Welland in

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★ ★ ★

Mr. Morin was a member of the Executive Council of the Canadian Manufacturers' Association and a past Chairman of the Hamilton-Brantford branch of that organization. During the second world war he served as Chairman of Wartime Housing in Hamilton.

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ABRASIVES—
Amplex Corporation, West Hartford, Conn.
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Norton Co., Worcester, Mass.

ACID INHIBITORS—
(See Inhibitors, Pickling)

ADJUSTABLE SPEED DRIVES—
The Louis Allis Company, Milwaukee, Wisc.

ANNEALING MACHINES — Electric Resistance
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

BAKERS—
(See OVENS—Rod Bakers)

BOBBINS—Braider & Wire Weaving
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg C., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Plastic Mold Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

BORAX—Wire Drawing
United States Borax & Chemical Corp., Pacific Coast Borax Co. Div., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CABLE FILLERS—Paper
Plymouth Cordage Company, Plymouth, Mass.

CAPSTANS—for Wire (also Caterpillar Types)
Bartell Machine-Tool Corporation, Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Entwistle Manufacturing Corporation, Providence, R. I.
Litzler, C. A. Co., Inc., Cleveland, Ohio

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

CASTINGS—Wire Mill
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

CATALYSTS—For Fume Elimination
Oxy-Catalyst, Inc., Industrial Div., Wayne, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Parkin Chemical Co., The, Pittsburgh, Pa.
Rome Soap Manufacturing Co., Rome, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.

CLEANING & PICKLING EQUIP.—
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, Ohio
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee Engr. Co., Cleveland, Ohio

CLOTH—WIRE, All Metals
Wickwire Bros., Cortland, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H., Co., Homer, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.
Tri-State Industrial Lubricants, Morton Grove, Illinois
United States Borax & Chemical Corp., Div. Pacific Coast Borax Co., New York, N. Y.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.
Miller, R. H. Co., Inc., Homer, N. Y.

COMPOUNDS—Diamond (Pre-Mixed)
Amplex Corporation, West Hartford, Conn.
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago
Rusch Wire Die Corporation, Croton-on-Hudson, N. Y.

COMPOUNDS—Extrusion for Wire
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Products Corporation, New York, N. Y.

COMPOUNDS—For Improving Drawing & Extrusion
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Phosphate Coating
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corporation, Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.
Rome Soap Manufacturing Co., Rome, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Standard Industrial Compounds Co., Frankfort, Ill.

COMPOUNDS—Vinyl
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Rome Soap Manufacturing Co., Rome, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.
Swift & Company, Chicago, Ill.
Tri-State Industrial Lubricants, Morton Grove, Illinois
United States Borax & Chemical Corp., Pacific Coast Borax Co. Div., New York, N. Y.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

CONTAINERS—Wire Packaging
(See DRUMS—Wire Packaging)

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Plastic Mold & Engineering Co., Providence, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket. R. I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

COUNTERS—
(See MACHINERY—Measuring Wire and Cable)

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co.. Detroit
Vascoloy-Ramet Corp., Waukegan, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Somerville, Mass.
Robinson, M. W. Co., Rockfall, Conn.

DIAMONDS—Industrial
Amplex Corporation, West Hartford, Conn.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Molina-Straus Diamond Products Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS
Amplex Corporation, West Hartford, Conn.
Danforth, The C. W. Co., Youngstown, Ohio
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
Industrial Diamond Powders, Inc., Pittsburgh, Pa.
Kelly Wire Die Corp., New York, N. Y.
Molina-Straus Diamond Products Co., New York, N. Y.
National Research Company, St. Clair Shores, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING—
Danforth, The C. W. Co., Youngstown, Ohio
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Industrial Diamond Powders, Inc., Pittsburgh, Pa.
Kelly Wire Die Corp., New York, N. Y.
National Research Co., St. Clair Shores, Mich.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIAMOND TOOLS—
Amplex Corporation, West Hartford, Conn.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Molina-Straus Diamond Products Co., New York, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide, Tungsten & Tantalum
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.

DIES—Cold Heading
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
Vascoloy-Ramet Corp., Waukegan, Ill.

DIES—Diamond
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., New Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES DIAMOND—Drawing Angle Controlled
Hoosier Wire Die, Inc., Ft. Wayne, Ind.

DIES DIAMOND—Reversible
National Wire Die Co., New York, N. Y.

DIES—Extrusion
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Kelloy Corporation, New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Polishing, Asbestos Wire
Beard Machine Co., York, Pa.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., New Nixon, N. J.
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Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.

DIES—Swaging
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tube Drawing
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Hoosier Wire Die., Inc., Ft. Wayne, Ind.
Indiana Wire Die Co, Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., Waukegan, Ill.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRIVES—Electric, Adustable Speed
Allis, The Louis Co., Milwaukee, Wis.

DRUMS—Wire Packaging
Continental Can Company, Van Wert, Ohio
Hubbard Spool Company, Garrett, Ind.

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Co., Garrett, Ind.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

DRYING EQUIPMENT—
Carl Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

ENGINEERS—Consulting
Bartell Machine-Tool Corporation, Rome, N. Y.
Wire Mill—Clarence S. Arms, Worcester, Mass.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FREQUENCY CHANGERS—
The Louis Allis Company, Milwaukee, Wisc.

FURNACES—Brazing
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio

FURNACES—Galvanizing Equipment
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.

FURNACES—Resisting Heating, Strand
Electric Furnace Company, Salem, Ohio

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio

FURNACES—Strand Annealing
Electric Furnace Company, Salem, Ohio

GAUGES—Wire Diameter, Continuous
Industrial Gauges Corporation, West Englewood, N. J.

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GEARMOTORS—
The Louis Allis Company, Milwaukee, Wisc.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS—
Bakelite Company Div. of Union Carbon & Carbide Corp., New York, N. Y.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
General Electric Company, Alkanex Wire Enamel Dept., Schenectady, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymouth, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Products Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

INSULATING MATERIALS—Paper (For Electric Wire Cable)
Plymouth Cordage Company, Plymouth, Mass.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Rome Soap Mfg. Co., Rome, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.
Tri-State Industrial Lubricants, Morton Grove, Illinois.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Bobbin Winders
Cedar West Tool Company, Inc., New York, N. Y.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., Bridgeport, Conn.
Wafios Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Closing Rope
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Cold Heading
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Morgardshammer Mek Verstads A. B., Morgardshammer, Sweden.
National Mach'y Exch (Used), New York
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Herborn, Germany

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Detroit
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven, Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Flat Wire
Fenn Manufacturing Co., Newington, Conn.
Mettler Machine Tool, Inc., New Haven, Conn.
Torrington Mfg. Co., Torrington, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Forming Wire
Baird Machine Co., Stratford, Conn.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Wafios Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Mfg. Co., Wallingford, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Beard Machine Co., York, Pa.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Labeling Electric Wire
Dewyer, Inc., Libertyville, Ill.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Cedar West Tool Company, Inc., New York, N. Y.
E. V. G., Richard Kleinhans, New York, N. Y.
Maschinen & Stahl A. G., c/o Richard Kleinhans, Zurich, Switzerland
Wafios Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Durant Mfg Co., Milwaukee, Wis.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Baird Machine Co., The Stratford, Conn.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.

MACHINERY—Pin Making
Baird Machine Co., The, Stratford, Conn.

MACHINERY—Plating
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York,
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Polishing Asbestos Wire
Beard Machine Co., York, Pa.

MACHINERY—Printing on Electric Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine-Tool Corporation, Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory, Robert J., Co., Newark, N. J.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
National Mach'y Exch. (Used), New York N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Rod Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Spark Testing
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Staple
Nilson, A. H. Machine Co., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Straightening & Cutting
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Patterson Machine, Geo. C., Co., Cleveland, Ohio

MACHINERY—Stranding
Bartell Machine-Tool Corporation, Rome, N. Y.
Godderidge Ste., Houilles, (Seine-et-Oise), France
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Stripping Electric Wire & Cable
Burdwood, Howard A., Inc., Portland, Maine

MACHINERY—Swaging
Fenn Manufacturing Co., Newington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Colbourne Machine Company, Winsted, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Fenn Manufacturing Co., Newington, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Federal Mfg. Co., Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine-Tool Corporation, Rome, N. Y.
Cook Manufacturing Co., The, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Turks Head
Fenn Manufacturing Co., Newington, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—Welded Wire Mesh
E. V. G., Richard Kleinhans, New York, N. Y.
Maschinen & Stahl A. G., c/o Richard Kleinhans, Zurich, Switzerland

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery —Welding Wire Fabrics)

MACHINERY—Winding Wire
Emory, Robert J., Newark, N. J.
Federal Manufacturing Company, Wallingford, Conn.
Fenn Manufacturing Co., Newington, Conn.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Federal Mfg. Co., Wallingford, Conn.
Fenn Mfg. Co., Newington, Conn.
Herborn, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
Morgardshammer Mek Verstads AB, Morgardshammer, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Forming
Baird Machine Co., The, Stratford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Wrapping with Paper
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Co., Boston, Mass.

MANDRELS—Extrusion
Bartell Machine-Tool Corporation, Rome, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MOTORS—Electric, A.C. & D.C.
The Louis Allis Company, Milwaukee, Wisc.

NAIL TOOLING—Tungsten Carbide
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAPER—Creped Wrapping
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Rinkle, Krinkle Paper Co., Inc., Boston, Mass.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Rinkle, Krinkle Paper Co., Inc., Boston, Mass.
Terkelsen Machine Co., Boston, Mass.

PAPER—Insulating
Plymouth Cordage Company, Plymouth, Mass.

PATENT—ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Monsanto Chemical Company, Plastics Division, St. Louis, Mo.
Pittsburgh Coke & Chemical Co., Pittsburgh, Pa.

PLASTICS COMPOUNDING—Custom
Plandex Corporation, Downingtown, Pa.

PLASTICS—for Wire Insulation
Bakelite Company Div. of Union Carbon & Carbide Corporation, New York, N. Y.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plandex Corporation, Downingtown, Pa.
Shawinigan Resins Corporation, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Products Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

PRINTING WHEELS—for Electric Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gillies, Duncan M. Co., Inc. Boylston, Mass.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

PUMPS—Molten Metal
Fisher Associates, New York, N. Y.

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Industrial Ovens, Inc., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company The, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company The, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Masonware Company, East Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., New York, N. Y.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company The, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Masonware Company, East Providence, R. I.
McCaskie, Inc., William, Westport, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Company, New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Aluminum
Aluminum Company of America, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Aluminum Company of America, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Co., Phosphor Bronze Div., Seymour, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—Braider, Wire
Plastic Mold & Engineering Co., Providence, R. I.

SPOOLS—Plastic
Hubbard Spool Company, Garrett, Indiana
Standard Mill Supply, Co., Pawtucket, R. I.

SPOOLS—Stamped Metal for Retail Wire Sales
Masonware Company, East Providence, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STOCK STORAGE SYSTEMS
Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

TABLES—Press Feeding
Jarke Manufacturing Co., Chicago, Illinois

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TOOLS—Wire Cutting
Porter, H. K., Inc., Somerville, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRANSMISSIONS—Variable speed (See Adjustable Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Bartell Machine-Tool Corporation, Rome, N. Y.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Alkanex Wire Enamel Dept., Schenectady, N. Y.
Shawinigan Resins Corporation, Springfield, Mass.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila, Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
Micro Products Co., Chicago, Ill.
Strecker, August, K.G., Limburg/Lahn, W. Germany

WHEELS—for Printing on Electric Wire
Gem Gravure Company, West Hanover, Mass.

WIRE—Aluminum
Aluminum Company of America, Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Company, Phosphor Bronze Div., Seymour, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Chase Brass & Copper Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat, Fine
Montgomery Co., The, Windsor Locks, Conn.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
Aluminum Company of America, Pittsburgh, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Riverside-Alloy Metal Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Company, Phosphor Bronze Div., Seymour, Conn.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Metalizing
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Worcester Wire Works Div., National-Standard Company, Worcester, Mass.

WIRE—Needle
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio
Riverside-Alloy Metal Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Seymour Mfg. Co., Phosphor Bronze Div., Seymour, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Riverside-Alloy Metal Div., H. K. Porter Company, Inc., Prospect Park, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Riverside-Alloy Metal Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Roebling's John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Crucible Steel Co. of America, Pittsburgh, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Riverside-Alloy Metal Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

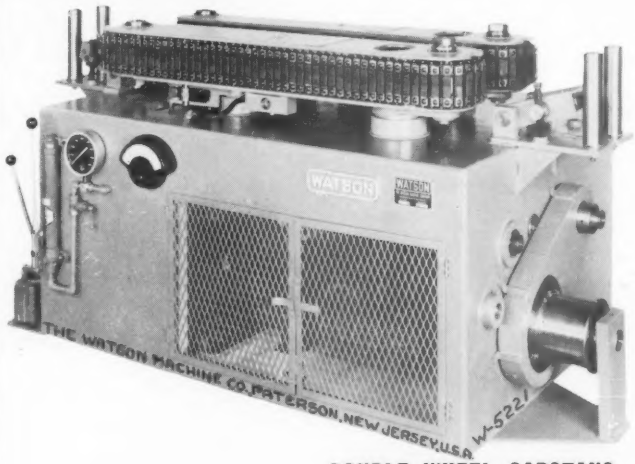
PATERSON 3, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE AND MASTICATING MACHINERY MANUFACTURERS

WATSON

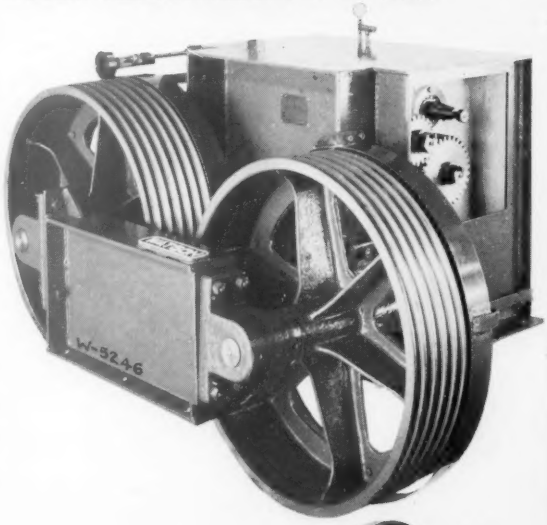
CAPSTAN SECTIONS

HEAVY DUTY DESIGNS OFFERED IN MANY TYPES AND SIZES. TRANSPOSABLE CHANGE GEARS OR VARIABLE SPEED DRIVES. SUPPLIED AS AN INTEGRAL PART OF OUR MACHINES OR SEPARATELY.



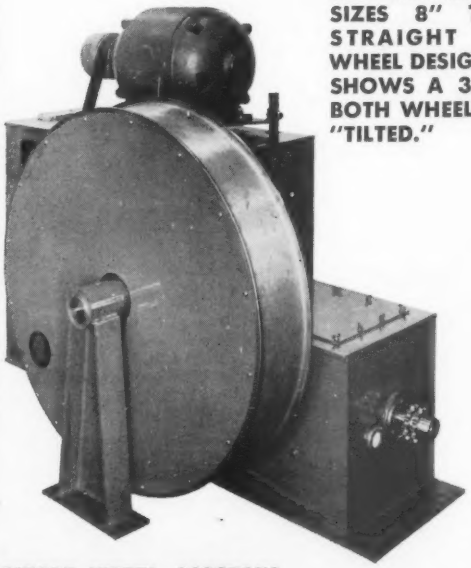
TRACTOR CAPSTANS

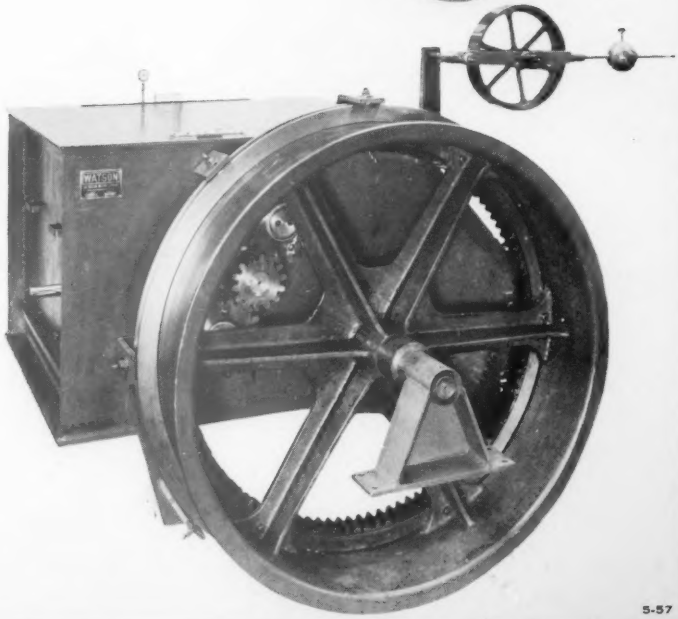
HANDLE CABLES WITHOUT BENDING, ESPECIALLY SUITED FOR TAPED OR UNCURED RUBBER COVERED CABLES. No. W-5221 SHOWS 6" MAX. DIA. UNIT WITH PULL-IN WINCH. ALSO AVAILABLE IN 4" SIZE.



DOUBLE WHEEL CAPSTANS

FOR HIGHEST HAUL PULLS. SIZES 8" TO 96" DIA. STRAIGHT OR "TILTED" WHEEL DESIGN. No. W-5246 SHOWS A 36" UNIT WITH BOTH WHEELS DRIVEN AND "TILTED."





SINGLE WHEEL CAPSTANS

AVAILABLE WITH STRAIGHT OR TAPERED FACE WHEEL IN SIZES 20" TO 118" DIA. No. W-4390b SHOWS A 36" REEVES DRIVEN UNIT. No. W-3520 SHOWS A 60" GEAR CHANGED UNIT WITH BALL-BEARING, ADJUSTABLE, FULL RING FLEETER. OTHER TYPE FLEETERS AVAILABLE.

5-57

Two of the large EF combination gas fired and electrically heated furnaces we built for uniformly annealing, normalizing, galvanizing, and producing other surface and metallurgical conditions on strip—continuously.

70* Strip Line Installations --- 7 More in Process

The Electric Furnace Company has designed, built and installed gas fired and electric furnace equipment for the following continuous strip steel processing lines:

18 for galvanizing and aluminizing steel strip
25 for processing silicon steel strip
12 for bright annealing stainless steel strip
9 for miscellaneous operations on high and low carbon strip
6 for special strip processes—not publicized
7 more are now in process of engineering and building

Considerable engineering experience, ability and "know how" were important factors in designing, building, and installing this equipment—for some of the world's leading strip producers and processors.

We have the engineers, the research, the experimental and the complete manufacturing and erection facilities to handle your ferrous or nonferrous strip, wire, tubing or any other heat processing problem.

*Approximately 90% of the above equipment was completed since 1945.

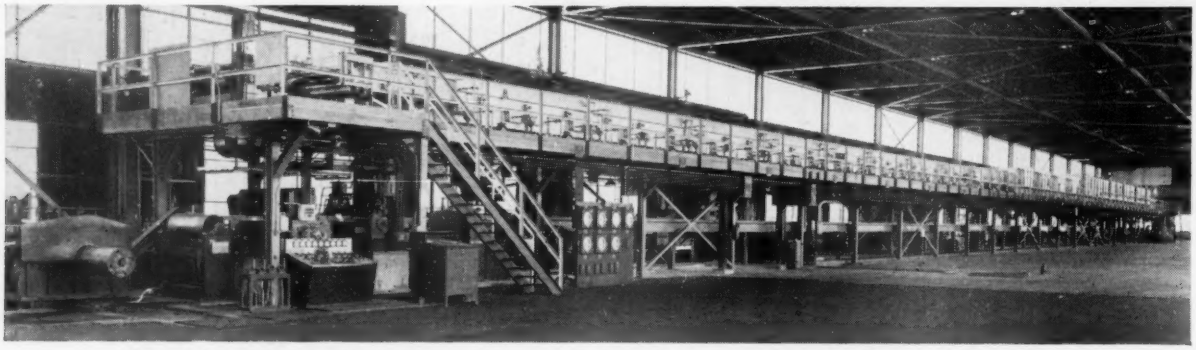
EF

THE ELECTRIC FURNACE CO.

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem - Ohio

Canadian Associates • CANEFCO LIMITED • Toronto 1, Canada



One of the numerous types of continuous furnaces we have built for processing various grades of silicon strip.